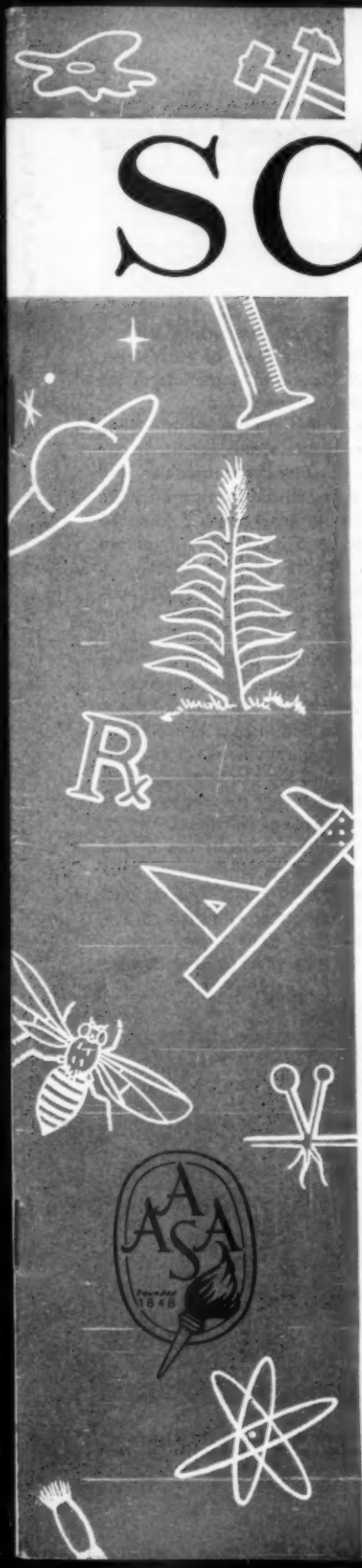


SCIENCE

10 SEPTEMBER 1954

VOLUME 120 NUMBER 3115

Identification of a Violet Receptor in Human Color Vision: *E. Auerbach* and *G. Wald* 401

Social Implications of the Genetics of Man: *A. H. Sturtevant* 405

Byron Cummings, Archeologist and Explorer: *N. M. Judd* 407

News and Notes

Some New Scientific Trends in Meteorology; Acoustics and the Structure of Liquids; Brazilian Congress of Chemistry; International Astronomical Union; and Regular Departments 408

Book Reviews

Atlas of Exfoliative Cytology; Physical Meteorology; Introduction to Chemistry; Organic Coating Technology; Chromium; Zirconium; Basic Botany; Relaxation Methods; Applied Electronics; The Proteins; Principles of Biochemistry; and Miscellaneous Publications 421

Technical Papers

Fractionation of Human Serum Albumin Using Continuous Filter-Paper Electrophoresis: *D. L. Larson* and *E. Feinberg* 426

Effect of High Fat Feedings on Viscosity of the Blood: *R. L. Swank* 427

New Method for Study of Intracellular Parasites with the Electron Microscope: *B. N. Dutta* et al. 428

Effect of Azide and Cyanide on the Respiration of a Species of *Mycobacterium*: *F. Bernheim* 430

Site of Conversion of Desoxycorticosterone Acetate to Progestin: *E. A. Lazo-Wasem* and *M. X. Zarrow* 431

Light-Scattering Studies on Hyaluronic Acid: *B. S. Blumberg* and *G. Oster* 432

Communications

Depiction of the Lecithin Molecule: *A. W. Devor* 434

"Big Business Takes Over Research": *P. Reichert* 434

Interaction between Casein and β-Lactoglobulin on Heating: *W. A. McGugan* et al. 435

Antibiotic-like Substance and Cellulose Digestion Stimulator Found in Fermented Feeds and in Rumen Fluid: *G. B. Garner* et al. 435

Tarahumara Indian Piscicide: *Gilia macombii* Torrey: *D. C. Gajdusek* 436

The Scientists Must Speak Up 11A

Meetings & Conferences 20A

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

the new *Lab-aid* way to store and view color transparencies

Assembly of Lab-aid Transparency Tray Cabinets, with the illuminator cabinet drawer pulled out. Use the table base, or stack them with your present Lab-aid Files.

You know how efficiently Technicon Lab-aid cabinets bring order to the filing of microslides, paraffin blocks and associated materials in the pathologic laboratory.

Now, in this new addition to the Lab-aid Filing System, you can enjoy the same benefits in the filing and viewing of color transparencies and lantern slides. The new Lab-aid transparency file has 40 smooth-sliding flat trays, each holding 16 standard 2" mounts, or 5 3¼" x 4¼" lantern slides in full view. They're easy to insert . . . you just drop them flat in the grooved frames. Easy to remove, too, by popping them out from underneath.

The special cabinet with its pull-out illuminator drawer lets you view a whole tray of transparencies at a glance, without removing any of them. Sitting or standing, you can inspect hundreds of slides under ideal viewing conditions without stirring from your place. And the disappearing shelf is a mighty handy place to lay slides down temporarily while you're working with them.

Both tray and illuminator cabinets are of the same dimensions and finish as all the other units in the Technicon Laboratory Filing System, and can be stacked interchangeably with them. If you would like more information about these or other units of the system, we'll be glad to send details.

The disappearing shelf is convenient as a temporary resting place for slides while working with them.

Inspect all your slides without removing any of them, or even stirring from your place.

Other units in the Lab-aid line

1" MICROSLIDE DRAWER FILES
2" SLIDE OR TRANSPARENCY DRAWER FILE
4" SLIDE OR INDEX DRAWER FILES
MICROSLIDE FLAT-FILING TRAY CABINET
PARAFFIN BLOCK FILE

technicon *Lab-aid* filing system

THE TECHNICON COMPANY
215 East 149th St., New York 51, N. Y.

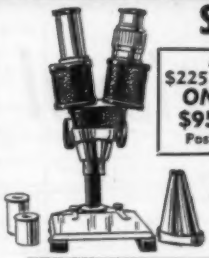
These same Cabinets are manufactured by our French Corporation.
COMPAGNIE TECHNICON • 7 rue Georges Villa • Paris

SENSATIONAL OPTICAL BARGAINS

OPTICAL COLLIMATOR

This instrument, an item of war surplus, was originally designed to check navigational instruments. It is being used by industry as a collimator for optical instruments, for testing lenses for definition, as a source of infinite light, and for photographing reticles at infinity. It is also being purchased by many firms as a source for the fine lenses and parts it contains. Consists of a large cemented achromat, 5" in diameter, with a focal length of approximately 25", a pin point reticle lighted by a 6–8 volt bulb (to represent a star), a first-surface mirror to reflect the light from the reticle. Overall length 14⅝"; width of cradle 7⅝". Slightly used, but guaranteed in good working order. Shpg. wt. 15 lbs.

Stock No. 80,025-W ..... **$95.00 f.o.b. Barrington, N. J.**



STEREO MICROSCOPE

WITH CHANGEABLE OBJECTIVES

A $225 Value ONLY $95.00 Postpaid

Now! Depth in a Magnified Erect Image!

Fine, imported Binocular Microscope at a substantial saving. Used for inspections, examinations, counting, checking, etc. Erect image. 2 pairs of eyepieces. 2 pairs of objectives. Power range from 13X to 75X. Variable interocular distance. Will accommodate standard eyepiece reticles. Rack and pinion variable tension focusing. Hardwood carrying case included. Accessories available. Recommended for lab, shop, factory or home use. We guarantee complete satisfaction.

Order Stock No. 70,036-W ..... **$95.00 Postpaid**

Send check or M.O. or order on open account

Optical Parts from $12,000 U.S. Govt. Height Finder—Mounted Objectives, Penta Mirror Assemblies, Eyepiece Assemblies, etc. **Write for Bulletin #25-W**

New! 2 in 1 Combination!
Pocket-Size
50 POWER MICROSCOPE and 10 POWER TELESCOPE
ONLY **$4.50 ppd.**

Useful Telescope and Microscope combined in one amazing, precision instrument. Imported! No larger than a fountain pen. Telescope is 10 Power. Microscope magnifies 50 Times. Sharp focus at any range. Handy for sports, looking at rare objects, just plain snooping.

Order Stock #30,059-W **$4.50 ppd.**

Send Check or M.O. Satisfaction Guaranteed!

SPITZ JR. PLANETARIUM

One of the Greatest Scientific Toys We Have Ever Offered!

Designed by Armand Spitz, world-famous maker of the Spitz Planetarium. Projects nearly 400 stars, more than 70 constellations in their correct relationships. Use it in any darkened room of the house, project it on the ceiling. No batteries, works on ordinary household current. Two simple adjustments that show you the sky as it appears from any point in your hemisphere . . . for any month of the year! Rheostat control for brightness. 32-page book included free of extra cost. Contains valuable information about the stars, provides easy identification of the constellations.

About 14" high on a 7" base. Projection sphere 7" diameter. Weight 3 lbs.

Stock No. 70,040-W ..... **$15.00 Postpaid**

IMPORTED MICROSCOPE—100, 200, 300 Power
1 Ocular, 3 Objective Lenses, Rack & Pinion Focusing
Revolving disc-light adjustable mirror. Square stage 2¾" x 2⅝". Truly a wonderful bargain. TRY IT FOR TEN DAYS — If not completely satisfied, your money refunded. Comes packed in sturdy, hardwood case. Accessory eyepieces and objective available.

Stock No. 70,008-W ..... **$14.95 Postpaid**

SPECTRAL LAMPS The Famous German OSRAM SERIES

SPECTRAL LAMPS (famous German Osram Series) Used in instruments requiring a monochromatic light source or a segment of the spectrum. All lamps fit a standard medium prefocus socket. Supply voltage: 220 A.C. Amperage: 1.0 to 1.5.

Stock No.	Vapor	Price Pstpd.	Stock No.	Vapor	Price Pstpd.
50,054-W	Cadmium	$29.20	50,060-W	Sodium	$29.20
50,055-W	Cesium	29.20	50,061-W	Neon	29.20
50,056-W	Helium	29.20	50,062-W	Rubidium	29.20
50 057-W	Mercury	29.20	50,063-W	Thallium	29.20
50,058-W	Mercury Cadmium	32.30	50,064-W	Zinc	29.20
50,059-W	Potassium	29.20	50,065-W	Mercury Sulphide	38.48

60° SPECTROMETER PRISM

Polished surfaces flat to ½ wave-length. Angle tolerances 5 minutes. Dimensions of polished surfaces 18mm. x 30mm. Made from dense flint glass, free of strine and strain. Ideal for use with all models of spectrometers.

Stock No. 30,143-W ..... **$8.25 Pstpd.**

ILLUSTRATED INSTRUCTION BOOKLETS

Easy to follow—accurate—8½ x 11 page size—many illustrations. Do-it-yourself—Save! and have Fun!

	Stock No.	Price Pstpd.
How to Build Projectors	9014-W	30¢
Homebuilt Telescopes	9006-W	40¢
Method to Clean Precision Optics	9024-W	25¢
Homebuilt Riflescopes	9018-W	30¢
New—Just Issued		
ULTRA CLOSE-UP Photography	9042-W	60¢
Infra-Red Light and Its Uses	9040-W	75¢
Homemade Stereo-Adapters	9032-W	35¢
Homemade Stereo-Viewers	9034-W	30¢
Photo Micrography with Pen Microscope	9029-W	10¢
Dummy Cameras	9035-W	20¢
Collimating Systems	9031-W	15¢
All About Telephoto Lenses	9036-W	60¢
Building A Condenser Enlarger	9038-W	40¢

INFRA-RED LIGHT and ITS USES

16 page illustrated Booklet dealing with all phases of Infra-Red projects—including Telescopes, Infra-Red microscopy-photography, watch-dog systems and communications. Includes list of materials.

Stock No. 9040-W ..... **75¢ Pstpd.**

LOOK! INFRA-RED ITEMS!

INFRA-RED FILTERS — 5⅛" dia.

For use with infra-red telescopes, camera attachments, etc. Light from a 100-watt bulb passing through the filter is transformed to infra-red light source. Used on jeep headlights with infra-red driving instruments. ⅛" thickness.

Stock No. 60 033-W ..... **$2.00 ea. Pstpd.**

BOOKLET ON INFRA-RED TUBES AND THEIR MILITARY APPLICATIONS — Reprinted from RCA REVIEW

Stock No. 9,223-W ..... **25¢ Pstpd.**

(Watch for our booklet "Infra-Red Light and Its Use" coming soon!)

INFRA-RED IMAGE TUBE

Used inside an infra-red telescope, this miniature tube converts infra-red rays to visible rays on the tube screen, which is viewed by an ocular. British import. Cylindrical shape, approximately 2" diameter, 1⅝" long. Requires standard vibra-rock electrical source.

Stock No. 50,046-W ..... **$7.95 Pstpd.**

IF YOU'RE INTERESTED IN OPTICAL BARGAINS
Write for FREE CATALOG W
We Have Literally Millions of War Surplus Lenses and Prisms for Sale at Bargain Prices. Numerous Types of Instruments Too!

ORDER BY STOCK NO. Satisfaction Guaranteed Send Check or M. O.

EDMUND SCIENTIFIC CORP., BARRINGTON, N. J.

A New International Centrifuge

FOR THE

Modern Laboratory

The new INTERNATIONAL MODEL U is more than just a Centrifuge in a cabinet. International's experienced engineering has produced a Centrifuge with years-ahead features and unmatched performance.

You will want to know more about the new aerodynamic guard bowl ventilating system—the new stainless steel interior — the stainless steel auxiliary cover that saves valuable bench space — the electric tachometer — the electric time clock — the unique air-filtering system—the spring-loaded hinge — the new vibration dampening system which results in smooth operation without the "shaker" action of over-flexible mountings — the versatility of 84 interchangeable accessory combinations.

Let us tell you more about this completely new Centrifuge, handsomely designed to fit in with your wall counters and cabinets. Write for Bulletin J explaining all these features in detail.

INTERNATIONAL EQUIPMENT COMPANY

1284 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

NEWS FOR LABORATORIES ON A LIMITED BUDGET

UNITRON Microscopes offer proven value and quality!

UNITRON Phase Contrast, MPE

Indispensable for the study of living cells and other highly transparent material. Continuous transition from phase to bright-field microscopy by adjusting condenser height. Choice of 4 contrasts. Mechanical stage. Three phase objectives: P10X, P40X, P100X. Eyepieces: 5X, 10X, 15X.

Only **$265.**

UNITRON Universal Camera Microscope and Metallograph

A completely self-contained unit for visual observation, projection, and photography of both opaque and transparent specimens. Built-in 3¼" x 4¼" camera, transformer, and illuminator. Optics include 5 objectives and 7 eyepieces. Mechanical stage, polarizing apparatus, micrometers, etc. Magnification: 25–2000X. Additional accessories available.

Only **$1,145.**

UNITRON Auto-Illumination, MLU

An ideal laboratory or medical microscope. Built-in illuminating system with transformer housed in microscope base. An eyepiece projection prism is included which makes the instrument a self-contained small projector. Graduated mechanical stage. Objectives: 10X, 40X, 100X. Eyepieces: 5X, 10X, 15X.

Only **$229.**

UNITRON Stereoscopic, MSH

A versatile laboratory instrument giving an exceptionally wide field of view with great depth of focus. Inclined binocular head with distance and diopter adjustments. Revolving nosepiece. Separate low stand. Choice of 3 objectives among 1X, 2X, 3X, 6X. Eyepieces: 8X, 12X, 15X.

Only **$314.**

UNITRON Metallurgical, MMU

For metals and opaque specimens, and also transparent specimens under both ordinary and polarized light. Vertical, oblique, and transmitted illumination. Transformer housed in microscope base. Focusable stage. Polarizing apparatus and filters. Objectives: 5X, 10X, 40X, 100X, Eyepieces: 5X, 10X, 15X.

Only **$287.**

Proper instrumentation is essential for efficient laboratory performance.

Yet only recently microscopes were so costly that many laboratories operating on a restricted budget were forced to content themselves with outmoded instruments of limited effectiveness. Furthermore, the more specialized types of microscopes were rarely to be found in the average laboratory, and problems to which they could contribute effectively had to be approached by indirect and less efficient methods.

The low cost of UNITRON MICROSCOPES has made it possible for even the laboratory with limited resources to have at its disposal modern microscopes of unsurpassed precision. Large organizations as well as small have been quick to recognize the outstanding value of UNITRON MICROSCOPES as well as their unexcelled optical and mechanical performance. Well known users include leading universities; industrial firms, and research laboratories such as:

Harvard University	Carbon and Carbide Chem. Co.
General Motors Corp.	Brown University
U. S. Dep't. of Agriculture	General Electric Co.
Cornell University	Northwestern University
Princeton University	Corn Products Refining Co.
University of Michigan	Mass. Inst. of Technology
CBS Hytron	Arthur D. Little, Inc.
Int. Business Machs. Corp.	Raytheon Manufacturing Co.
U. S. Army	McGill University
Bowdoin College	Schering Corp.

The UNITRON Microscope Catalog is yours for the asking!

This colorful illustrated catalog gives complete specifications on all of the instruments briefly described on this page as well as others which we know you will find of interest. Write for your free copy.

UNITED SCIENTIFIC COMPANY

204-6 Milk St., Dept. SM, Boston 9, Mass.

UNITRON Photomicrography Set

Duplicates the performance of costly apparatus. Mounting brackets adjust to accommodate your present camera (35mm., No. 120, No. 127, etc.). Viewing telescope permits all adjustments to be made while camera is in place and allows continuous observation of the specimen even during time exposures.

Only **$39.95**

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D. C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of March 3, 1879. Annual subscriptions: $7.50; foreign postage, outside the Pan-American Union, $1; Canadian postage, 50¢.

hot air—at temperatures you can depend on

No more worry about "hot" and "cold" spots. This Castle heavy-duty Hot Air Sterilizer has uniform temperatures throughout.

Specially placed baffle-plates and circulation fan provide temperature accuracy of 4°C. at *any setting* between 38°C. and 260°C. Temperature control is fully automatic.

This good uniformity and wide range help you get more precise and controlled results.

Sterilizer built entirely of stainless steel. Heavy 22 gauge. Non-corrosive, heat resistant. Won't warp or buckle. Will give you years of tough service, no matter what your load requirements are.

Double stainless steel walls lined with 2″ of rock wool. Inside size: 30″ x 36″ x 20″. Complete with 3 stainless steel shelves, heater, fan, and motor.

Don't go on depending on uneven sterilization when you can be *sure*. Phone your Castle dealer, or write for Bulletin Q-8.

Castle BACTERIOLOGICAL APPARATUS

WILMOT CASTLE CO.

1212 UNIVERSITY AVENUE, ROCHESTER, N. Y.

LaMOTTE pH BLOCK COMPARATOR

This improved LaMotte Unit greatly facilitates simple, accurate, Hydrogen Ion Control. It is especially recommended for the use of individual operators on any step of a process where a definite pH value must be maintained. Even with highly colored or turbid solutions determinations can easily be made with accuracy.

The new plastic block comparator is non-corrodible, moisture-resistant, and has more sharply defined color fields.

Complete with any one set of LaMotte Permanent Color Standards, together with a supply of the corresponding indicator solution, measuring pipette and marked test tubes.

LaMOTTE WATER SOLUBLE pH INDICATORS
(Sulfon-phthalein series) pH 0.2–9.6

These products were originally developed in the LaMotte laboratories and are of the same superior quality as the acid form indicators hitherto available for pH work.

They have the distinct advantage of being instantly soluble in distilled water, hence are easy to convert to solution form. Use of alkali, as required in the older technic, is eliminated, and no heating is necessary.

The clean quick way to prepare indicator solutions for accurate pH work.

LaMotte Chemical Products Company
Dept. "H" Towson 4, Md.

DIAGNOSTIC TOOLS

4-ACETYLAMINOANTIPYRINE
—for determination of body water

PROTARGOL-S
—for staining nerve tissue

WIN 3000
—for bone decalcification

WINTHROP

Winthrop-Stearns INC.

SPECIAL CHEMICALS DIVISION
1450 Broadway, New York 18, N. Y.

LARGE CYLINDERS for COMMERCIAL USE

Ample stocks in large cylinders of all gases carried at both our East Rutherford, N. J. and Joliet Ill. plants.

MEDIUM-SIZE CYLINDERS for PILOT-PLANT and LABORATORY USE

Three different sizes of cylinders containing approximately 5%, 10% and 30% of the contents of large commercial cylinders. These cylinders are designed for use on benches and in hoods and are readily portable.

"LECTURE BOTTLES"

for Research Experiments or Classroom Demonstrations.

71 different gases of highest purity are available in these little cylinders which have a diameter of 2" and an overall length of 15½".

Matheson's Complete Line of Triple-Tested

AUTOMATIC PRESSURE REGULATORS and NEEDLE VALVES

assure you of the correct type of control required for each gas.

MATHESON BULLETIN

NEW GASES NOW AVAILABLE

Extra Dry Hydrogen
Carbonyl Sulfide
Silicone Tetrafluoride
Chlorotrifluoroethylene
3-Methylbutene-1

Specialists in COMPRESSED GASES

From Acetylene to Xenon, Matheson has *all* the gases! Any rare or common gas, or any mixture thereof that you may need in your work is available from the Matheson Company.

Our new catalog listing the prices of 71 gases and mixtures also shows the pressure at which various gases are packed, their purity and the sizes of cylinders in which they may be obtained, as well as the proper type of pressure or flow control to be used. Write for our new price list dated April, 1954.

THE MATHESON COMPANY INC.

EAST RUTHERFORD, N. J. • *JOLIET, ILLINOIS*

ALL THE CHEMICALS NORMALLY USED IN THE LABORATORY
are also available from
THE MATHESON, COLEMAN & BELL
Division of
THE MATHESON COMPANY

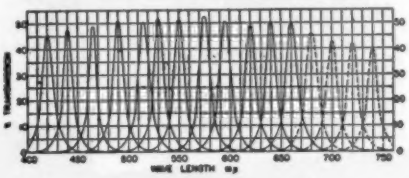
ORGANIC and INORGANIC REAGENT CHEMICALS
STAINS and SOLUTIONS

M C&B

G.A.B. Interference Filters

(Made in Switzerland)

for isolating narrow spectral bands



Spectral Range: 400-900 millimicrons
Spectral Width: 12-15 mμ, Transm.: 45-50%
Size: 2" x 2". Other sizes on order.

For

Flame Photometry and Color Densitometry
Microscopy and Photomicrography
Colorimetry and Fluorimetry

also in reflectometry, light scattering measurements, microcolorimetry, refractometry, polarimetry, and in all other fields requiring monochromatic light in the visible and near-infrared range.

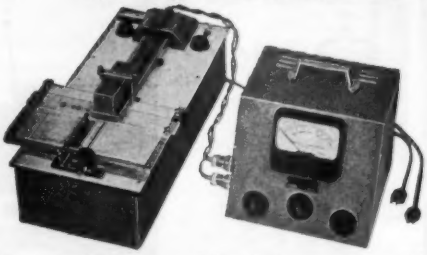
Write for Bulletin #180 to

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

PHOTOVOLT Densitometer

for

Partition Chromatography and Paper Electrophoresis



A photoelectric precision instrument for the rapid and convenient evaluation of strips and sheets of filter paper in partition chromatography and paper electrophoresis

Write for Bulletin #800 to

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

Also: Colorimeters | pH Meters | Multiplier Photometers
Fluorimeters | Nephelometers | Interference Filters

RESEARCH BIOCHEMICALS

OF

HIGHEST POSSIBLE PURITY

FOR INVESTIGATIONAL USES

AMINO ACIDS

A complete selection of more than 100 Amino Acids

Pre-tested for rigid specification adherence to assure highest possible purity for exacting requirements of Biochemical Research.

Typical Amino Acids

GAMMA AMINO BUTYRIC ACID
ASPARAGINE, D, DL, L
CANAVANINE SULPHATE
DL CITRULLINE
DL DIHYDROXYPHENYLALANINE
GLUTAMINE
HOMOCYSTEINE
HYDROXY-L-PROLINE
METHIONINE, D, DL, L
METHIONINE, SULFONE, SULFOXIDE
PHENYLALANINE, D, DL, L
SERINE, D, DL, L
THREONINE, D, DL, L
TRYPTOPHANE, D, DL, L
VALINE, D, DL, L

WRITE FOR NEW CATALOG

August 1954

Over 1200 Items

NBC

NUTRITIONAL BIOCHEMICALS CORPORATION

21010 MILES AVENUE • CLEVELAND 28, OHIO

~~NEARLY~~ ~~ALMOST~~

~~ABOUT~~ ~~CLOSE TO~~ ~~APPROXIMATELY~~

BE SURE!

with a

NEW IMPROVED

ROLLER-SMITH

PRECISION BALANCE

Featuring increased response and speed and employing Alnico magnets for damping, the new and improved Roller-Smith Precision Balance is capable of weight determinations ranging from 3 milligrams to 150 grams, in sensitivities from 2 micrograms to 20 milligrams. Available in a wide selection of models and ranges. Its attractively designed die cast case, in gray hammer-tone finish, is now fitted with snap latch doors for easy access.

When the quality of your product . . . the success of your research . . . depends upon precise weight measurements in a matter of seconds, you can rely on Roller-Smith Precision Balances . . . universally accepted as the standard for speed, accuracy and simplicity of operation. Catalog No. 4540 illustrates and describes all models . . . shows wide selection of pans and accessories. Write for your copy today.

These are but a few of the thousands of operations performed daily by Roller-Smith Balances.

Detects difference in weight of anesthetized insects before and after eating. (Biological Laboratories).

Insures quality of drugs and antibiotics in the research laboratory. (Pharmaceutical Manufacturers).

Counts thousands of tiny screws by weight. (Watch Manufacturer).

Measures accurate powder charge and lead slug for match rifle ammo. (Firearm Manufacturers).

Protects quality of women's hosiery . . . determining synthetic fiber size by weight. (Hosiery Mills).

Instrument Division

ROLLER-SMITH CORPORATION
1825 WEST MARKET STREET
BETHLEHEM, PENNSYLVANIA

Since 1908—producers of high quality electrical instruments, aircraft meters, rotary switches, relays and precision balances.

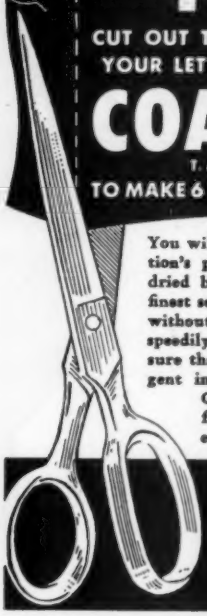
FREE!

CUT OUT THIS AD AND PIN IT TO YOUR LETTERHEAD FOR ENOUGH

COAGUSOL

T. M. REG. U. S. PAT. OFF.

TO MAKE 6 GALLONS OF SOLUTION!



You will find that a COAGUSOL solution's penetrating action strips stains, dried blood and tissue from even the finest serration of surgical instruments, without soap, without scrubbing—speedily, economically. Because we are sure that you will find this new detergent invaluable—we ask you to try COAGUSOL at our expense. For full information and your generous sample, write right now to

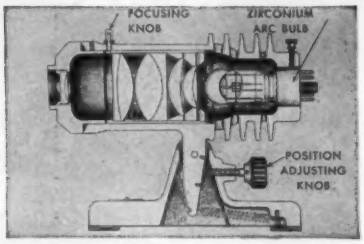
HOSPITAL LIQUIDS Incorporated

PRODUCTION LABORATORIES

Milledgeville, Georgia

New

Radically different!



"ZIRCONARC" PHOTOMICROGRAPHIC LAMP

For better black-and-white and color photomicrographs

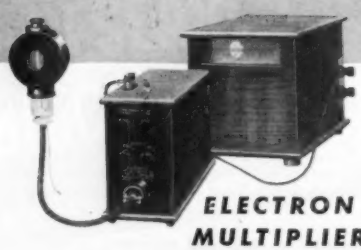
Combines the concentrated light of the Western Union arc light bulb (about 1 mm dia.) with our fluorite-coated, 7-element aplanatic optical system of highest correction, free from chromatic aberration. . . . Practically harmless to living cultures. . . . Built with the same precision as the microscope itself. Over-all length of lamp, 10". Height, 6½". Base, 4½" x 6½". Price, complete with power unit and 40-watt bulb, $325. Order direct or from leading supply dealers.

Write for Bulletin ZL-321S

FISH-SCHURMAN CORPORATION
74 Portman Road, New Rochelle, N. Y.

Fish-Schurman

FARRAND



ELECTRON MULTIPLIER

PHOTOMETER

For precise measurements, particularly at low light levels. Applicable for use in colorimeters, microscopy, fluorometry, flame photometry, etc.

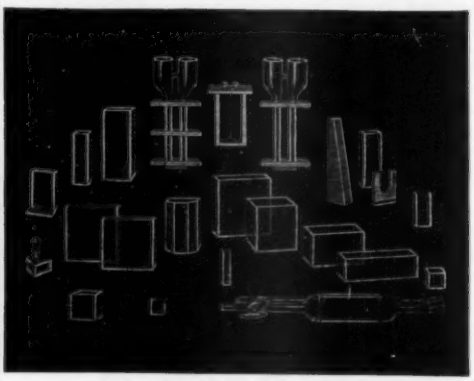
Selective wide range of sensitivity—Minimum detectable flux, 5x10—12 lumens—Linear response—Interchangeable photomultiplier tubes—Compact—and simple to operate.

Bulletin, No. 804 upon request.

- ENGINEERING
- RESEARCH
- DEVELOPMENT
- DESIGN and MANUFACTURE of PRECISION OPTICS ELECTRONICS and SCIENTIFIC INSTRUMENTS

FARRAND OPTICAL CO., Inc.
BRONX BLVD. & EAST 238th STREET
NEW YORK 70, NEW YORK

GLASS ABSORPTION CELLS made by KLETT



Makers of Complete Electrophoresus Apparatus

SCIENTIFIC APPARATUS

Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters—Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.
179 East 87 Street, New York, New York

Purina *laboratory animal* Nutrition News

FEEDING LABORATORY DOGS

By H. C. Schaefer, Director, Laboratory Chow Research

Dogs are valuable animals for research and testing in medical schools and research institutions. For their excellent service as research helpers, they deserve the best in care, housing, sanitation, and nutrition.

Purina has studied canine nutrition for more than a quarter of a century. This has included the nutrient requirements of dogs for maintenance, reproduction, and stress. In addition, there has been continuous study to learn the most economical, convenient, and palatable means of supplying the required nutrients.

The results of this research work have been incorporated into Purina Dog Chow Checkers and Purina Dog Chow Kibbled Meal.

Dog Chow Checkers are recommended for the maintenance of normal, healthy dogs. This product and fresh water should be kept before dogs at all times. About 1 lb. per day for 40-45 lbs. of body weight will keep dogs in excellent condition.

Dog Chow Kibbled Meal is recommended for dogs where palatability is a factor and where increased food intake is desired. This product was developed especially for dogs under stress of reproduction, lactation, growth, and circumstances associated with research investigations. It should be fed once or twice daily, moistened with water to make a desirable crumbly, hamburger-like consistency. A small percentage of raw or canned meat may be fed with Kibbled Meal to make it even more appetizing to dogs with poor appetities.

RALSTON PURINA COMPANY, St. Louis 2, Missouri

WITH OVER 5,000 DEALERS COAST TO COAST TO SERVE YOU

More Precision in Air Conditioning

Niagara "Controlled Humidity" Method provides air at precise conditions of temperature and moisture content.

In the range from below 32° F. to 140° F. you may have constant conditions within tolerances of 1° F. and 2% R. H. with control by thermostats alone... simple and inexpensive... no moisture sensitive instruments needed.

This Method uses "HYGROL" liquid absorbent to remove moisture from the air directly. Operation is automatic; the absorbent is re-concentrated, by a new, reliable method, at the same rate as it becomes diluted.

Use it for drying processes, preventing moisture damage to instruments or hygroscopic materials, controlled atmospheres for tests and experiments. Unit capacity ranges up to 20,000 c. f. m.

Write for Bulletins No. 121, 122, 125; address Niagara Blower Co., Dept. SW 405 Lexington Ave., New York 17, N. Y.

Now available...

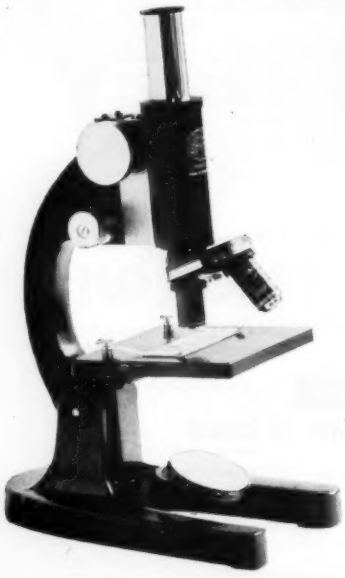
Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acil; Carotene, cryst.; Catalase; Cellulase Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetonamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyridyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Hordenine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropylarterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melezitose; Mesobilirubinogen; Muscle Adenylic Acid; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothenyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridzin; Phosphorylase; Piperin; Porphyrindine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salmine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

DELTA CHEMICAL WORKS, INC.
23 West 60th St. New York 23, N.Y.
Telephone Plaza 7-6317

NEW! GRAF-APSCO MICROSCOPES (All metal construction)

SCOOPING THE MARKET WITH LOWEST PRICES



MODEL GB_2 for General Biology

$118.00 Less 10% on five or more.

Old microscopes accepted in trade at highest allowances.

Has full range fine adjustment and all metal coarse adjustment, two sided (plano/concave) mirror and standard optics.

SOLD ON TEN DAYS APPROVAL

Guaranteed to please YOU or returnable at our expense.

Equipped with:
10 x Huyghenian Ocular
Achromatic Objectives
16 mm (10 x) n.a. 0.27
4 mm (44 x) n.a. 0.66
Double dustproof Nosepiece
Disc Diaphragm
Plano-concave mirror
(guaranteed not to fall out)

This is also the ONLY microscope where the base (feet) extends beyond to objectives, thereby protecting the lenses from bumping rear of cabinets, thereby maintaining parfocalism.

Write for our new catalogue for description of other models.

THE GRAF-APSCO CO.
5868 Broadway **Chicago 40, Ill.**

AAAS EDITORIAL BOARD

Duane Roller
Editor

Charlotte V. Meeting
Assistant Editor

Mark H. Adams
William R. Amberson
Wallace R. Brode
Bentley Glass
Karl Lark-Horovitz
Edwin M. Lerner
Walter J. Nickerson
William L. Straus, Jr.

Advertising Representative: F. A. Moulton

The Scientists Must Speak Up

THE problem of the effects of H-bomb explosions is terribly disturbing, but I do not think that a conference of scientists is what is needed to deal with it. There are too many conferences in the world today and too many decisions taken by them.

What the world should do is to listen to the warnings of individual scientists who understand this terrible problem. That is what would impress people and give them understanding and make them realize the danger in which we find ourselves.

Just look at the influence Einstein has, because of the anguish he shows in face of the atomic bomb.

It must be the scientists, who comprehend thoroughly all the issues and the dangers involved, who speak to the world, as many as possible of them, all telling humanity the truth in speeches and articles.

If they all raised their voices, each one feeling himself impelled to tell the terrible truth, they would be listened to, for then humanity would understand that the issues were grave.

If you and Alexander Hadlow [who has pleaded for a United Nations conference of scientists on the H-bomb] can manage to persuade them to put before mankind the thoughts by which they themselves are obsessed, then there will be some hope of stopping these horrible explosions and of bringing pressure to bear on the men who govern.

But the scientists must speak up. Only they have the authority to state that we can no longer take on ourselves the responsibility for these experiments; only they can say it.

There you have my opinion. I give it to you with anguish in my heart, anguish which holds me from day to day.

With my best wishes and in the hope that those who must advise us will make themselves heard.

ALBERT SCHWEITZER

This letter appeared originally in the London Daily Herald *and is reprinted here with Dr. Schweitzer's permission. It also was reproduced in the* Saturday Review *for 17 July at the suggestion of Eugene Exman, who is Dr. Schweitzer's American editor. Dr. Schweitzer currently is dividing his time between his home in Gunsbach, Alsace, France, and his hospital in Lambaréné, French Equatorial Africa.*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D. C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

Change of address: The notification should reach us four weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including postal zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, 50¢. Single copies 25¢. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

POLYETHYLENE WARE
FOR THE LABORATORY

NALGENE

PIPET BASKET

A basket of resilient, lightweight, chemically resistant polyethylene for handling pipets and other small glass items during soaking and washing.

A perforated screen is recessed ¾" into the base for complete drainage. Carrying handle of light-weight aluminum, completely sealed in polyethylene. All parts of thick polyethylene for rigidity and long life.

Cat. No. 83410

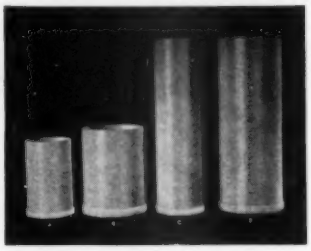
Size B (Use with 6½ x 9" B Jar) ... ea. $15.50
Size D (Use with 6½ x 18" D Jar) ... ea. $16.50

PREVENT BREAKAGE and ACCIDENTS

with

NALGENE PIPET JARS

• UNBREAKABLE
LIGHT WEIGHT
SAFE
RESILIENT



of unplasticized virgin polyethylene, chemically resistant, at room temperatures, to acids, alkalis, cleaning solutions and detergents.

Cat. No. 84918

Size A	(5" x 8")	ea. $ 9.00
" B	(6½" x 9")	" $10.50
" C	(5" x 18")	" $11.50
" D	(6½" x 18")	" $13.25
" E	(6½" x 18" to 27")	" $19.50
" F	(6½" x 27" to 36")	" $24.50

NALGENE

CENTRIFUGE TUBES

Cat. No. 84919

15 ml. cap. conical tube, ea., .50
50 ml. cap. round tube, ea., .55
(fits standard centrifuge shields)

Less 10% in lots of 36.
Less 15% in lots of 144, assorted.

NALGENE BEAKERS

Heavy Molded "Airothene"

Cat. No. 84910

Cap. ml.	25	50	100	150
Price, ea.	.65	.90	$1.05	$1.30
Cap. ml.	250	400	600	1000
Price, ea.	$1.45	$1.85	$2.75	$4.00

Lots of 12 of a kind, less 10%
Lots of 48, assorted, less 20%

NALGENE

KENUTUF FUNNELS

Designed properly for chemical work with 60 degree angle for rapid filtering and outside rubbing to prevent airlock.

Cat. No. 84915

Diameter	Stem Length	Overall Length	Price ea.
1½"	1½"	2⅝"	$ .20
2½"	1⅝"	3¾"	.35
3½"	1⅞"	5"	.60
4½"	2⅝"	6"	.90
5½"	3⅞"	8¼"	1.25
6½"	4⅛"	9½"	1.50
8½"	5"	11¾"	2.40

Less 10% in doz. lots. Less 15% in lots of 36.
Less 20% in lots of 144.

STANDARD SCIENTIFIC SUPPLY CORP.

34 West 4th Street • New York 12, N. Y.

ALL THE APPARATUS, EQUIPMENT, SUPPLIES, CHEMICALS AND REAGENTS NEEDED TO RUN TODAY'S MODERN LABORATORIES.

Identification of a Violet Receptor in Human Color Vision

Edgar Auerbach* and George Wald

Biological Laboratories, Harvard University, Cambridge

ONE of the most pressing tasks of visual physiology, still largely unfulfilled, is to identify the various types of cone concerned with human color vision and to learn their properties. Probably the closest approach to accomplishing this is found in the work of Stiles (*1*). Stiles measured the visibility of a small test stimulus of one color viewed foveally against an adapting field of another color. His measurements display characteristic inflections, like those that ordinarily mark transitions between cone and rod vision, although they involve the responses of cones alone. By analyzing these functions, Stiles has derived a trio of curves that appear to represent the spectral sensitivities of three classes of cone. De Vries (*2*) later reported similar measurements, leading to much the same result.

The present experiments (*3*) involve measurements of dark adaptation, which reveal the presence in the human retina of a species of cone selectivity sensitive to violet light, the excitation of which induces a violet sensation. The crux of the procedure is to adapt the eye very strongly with red, orange, or yellow light, which spares the violet receptor, and then to measure its dark adaptation with test lights of low wavelengths. In this way one finds that the first 2 to 3 min of dark adaptation are occupied with a receptor with maximal sensitivity in the neighborhood of 436 mμ.

Procedure. All our measurements of visual threshold were performed with the spectral adaptometer described earlier (*4*). In this instrument, 10 wavelengths are isolated with color filters from the radiation of a high-pressure mercury arc lamp. The test field was circular and subtended an angle of 1° with the eye. It was exposed for flashes of 1/5 sec. Its brightness was regulated with a pair of annular neutral wedges, rotating in opposite directions so as to compensate each other. A variable fixation point permitted the location of the image of the test field on any desired portion of the retina within a radius of 12° of the fixation point. The relative energies of the test illuminations were measured with a barrier layer photocell, calibrated at our laboratory and by the National Bureau of Standards.

For light adaptation, a 1000-w concentrated filament lamp was used, at a distance of 65 cm from a large lens (diameter 11.5 cm; focal length, 18 cm). The eye was placed at the lens focus, so as to be in the position of Maxwellian view, in which most of the lens surface appeared to be evenly illuminated. The wavelength composition of the adapting field was regulated with color filters, its brightness with neutral filters.

The brightnesses of both white and colored adapting lights were measured with a Macbeth illuminometer. That is, all brightnesses were evaluated in terms of the standard white of this instrument. The adapting lights used in our experiments were very bright indeed—of the order of 10^4 to 10^6 millilamberts.

Observations. Figure 1 shows the dark adaptation of a normal observer, following 5 min exposure to white light (5.0×10^5 millilamberts). Thresholds were measured at 621 mμ in the orange and at 436 mμ in the violet. Each dark-adaptation curve consists principally of two sections: a first rapid fall of threshold to a plateau, the adaptation of the cones; followed by a second fall of threshold to a final plateau, the adaptation of the rods. The cone section, measured at 436 mμ, persists for about 13 min and displays minor inflections; measured at 621 mμ, it is simple in form and persists for about 30 min. This is because the cones are much more sensitive to orange than to violet light, whereas in the rods this relationship is reversed (the Purkinje phenomenon). As a result, the transition from cone to rod thresholds is marked by a crossing of the dark-adaptation curves, a direct expression of the Purkinje shift.

Figure 2 shows a series of similar measurements following adaptation to lights of various wavelengths. The curves following white-light adaptation are similar to those of Fig. 1. Following adaptation to yellow light, containing all visible wavelengths longer than 490 mμ, much the same result is obtained.

Adaptation to orange light (> 520 mμ), however, produces a very different result. Dark adaptation measured at 621 mμ is much as before, but at 436 mμ it has changed markedly. For the first 2 min of dark adaptation, the threshold for violet light lies *below* that for orange, the reverse of the familiar cone relationship. After about 2 min, the curves cross in what may be called a reverse Purkinje shift. Then after about 15 min of dark adaptation, the curves cross again in the true Purkinje shift, marking the change from cone to rod thresholds. Adaptation to orange-red light (> 590 mμ) yields a similar result, somewhat accentuated.

Following such adaptations to orange-to-red light, the measurements at 436 mμ display two distinct cone plateaus, separated by a break; and frequently also—as in Fig. 2 at the lower right and in Fig. 3—associated with the shift to the second plateau, the color sensa-

tion at the threshold is reported to change. All these effects are evidences of the essential heterogeneity of cone dark adaptation.

The most significant feature of this result is the special sensitivity to violet light displayed by the cones in the first 2 to 3 min of dark adaptation. How is this achieved? Inspection of the curves in Fig. 2 shows that dark adaptation measured at 621 mμ is only slightly affected by the quality of light adaptation. The special effect of orange- or red-light adaptation is, not so much to raise further the threshold to orange light, as to fail to raise it to violet light. That is, the effect of orange or red light adaptation is not so much to increase the adaptation of red-sensitive receptors, as to spare a violet-sensitive receptor.

The spectral sensitivity of this receptor can be measured by a procedure illustrated in Fig. 3. Normal subjects were adapted repeatedly to intense orange-to-red light, and their dark adaptation was measured at 8 wavelengths available in our spectral adaptometer. Figure 3 shows a small sample of such data, selected from a long series of measurements with seven subjects. Between 5 and 12 min of dark adaptation, these curves exhibit the familiar relative sensitivities ordinarily associated with human cone vision; but during the first 2 min, the measurements made at 405, 436, and 492 mμ display the special properties of the violet receptor.

From such families of curves as shown in Fig. 3, extended to include the other wavelengths, one can read off values of the threshold at each wavelength, at 1 and 10 min of dark adaptation. In this way one obtains the spectral sensitivity curves shown in Fig. 4. They are plotted in terms of − log threshold, that is, log 1/threshold, or log sensitivity.

Figure 4 shows that at 1 min of dark adaptation following orange-to-red light adaptation, the spectral sensitivity of cone vision is dominated by a high, narrow peak, maximal in the neighborhood of 436 mμ. This is the sensitivity curve of the violet receptor. Beside it is the broad, subsidiary maximum at about 555 mμ ordinarily characteristic of cone vision. After 10 min of dark adaptation, the latter maximum has become dominant. Nothing remains of the violet maximum but a shallow inflection.

Such an inflection in the spectral sensitivity curve of human cone vision has been noted before. It is much accentuated in the region of the macula lutea, and has been ascribed there to the presence of the macular pigment, xanthophyll (*5*). The fact that peripheral areas of the retina also display a shallow inflection suggested that they too contain small amounts of macular pigment. It seems from the present observations, however, that in the peripheral retina this inflection is caused mainly by the violet receptor. The same effect must exist also in the central retina, where, however, an added inflection is superimposed on it, owing to the macular pigment.

We have as yet made measurements at too few wavelengths to define accurately the shape and position of the sensitivity curve of the violet receptor. The available data, however, are in good agreement with previous estimates of this function. In Fig. 4 we show for comparison Stiles's curve of what he calls the "blue mechanism" (*6*), here plotted to an arbitrary height (*1b*). Our curve agrees about as well also with the short-wavelength "Grundempfindung" of König and Dieterici, maximal at about 450 mμ (*7*).

We speak of this as the violet receptor because its maximum sensitivity is in the violet, and because when it alone is stimulated under the conditions we have described, normal observers ordinarily report the threshold sensation as violet. There is no opportunity here to go in detail into the vexatious question whether

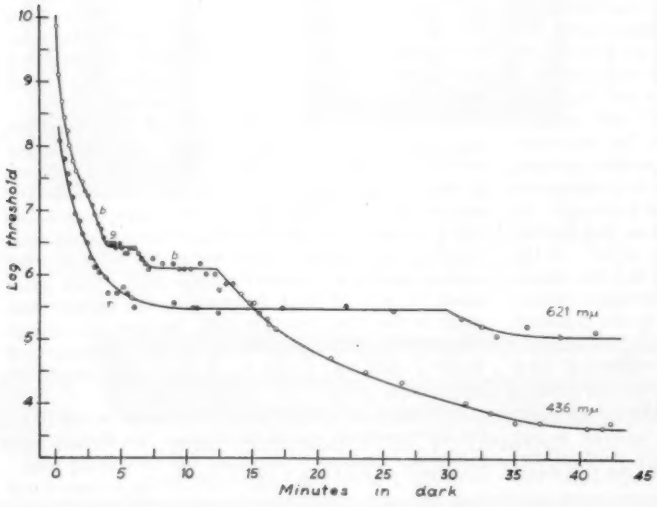


Fig. 1. Dark adaptation measured in the orange (621 mμ) and in the violet (436 mμ), following exposure of the eye to white light (5.0×10^5 millilamberts) for 5 min. A 1° test field was used, fixated 6° from the fovea, and exposed for flashes of 1/5 sec. All observations are monocular. Log threshold is expressed in relative energy units. Thresholds seen as colorless are plotted as open circles; others are marked with a small letter: *b*, blue; *g*, green; *r*, red. Each dark-adaptation curve consists of two main sections, separated by a break: a first portion, owing to the dark adaptation of the cones, followed by a second section, owing to the rods. Even the cone section as measured at 436 mμ displays inflections and changes of hue, caused presumably by the participation of various types of cone in the measurement.

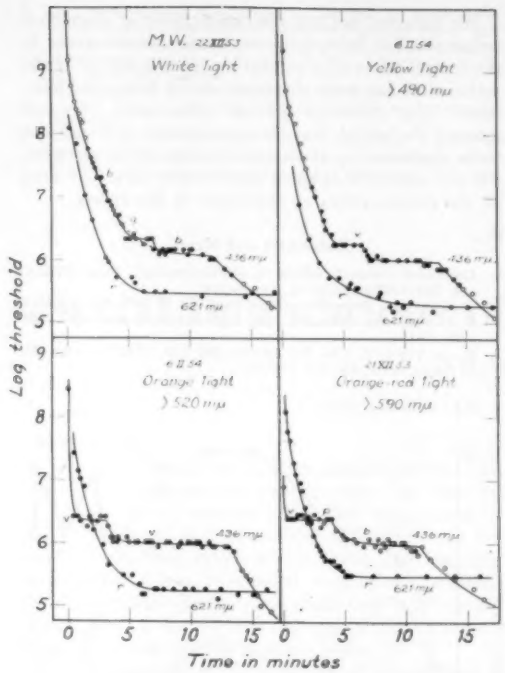


Fig. 2. Dark adaptation measured at 436 and 621 mμ following adaptation to lights of various wavelength composition. Otherwise as in Fig. 1. The colored lights used in light adaptation included all visible wavelengths above those stated in the heading of each figure. The adapting log brightnesses in millilamberts are as follows: white, 5.70; yellow, 6.34; orange, 6.15; orange-red, 5.87. As in Fig. 1, open circles represent thresholds seen as colorless; those seen as colored are accompanied by small letters: *v*, violet; *p*, purple; and so on. After exposure to the white or yellow light, the dark adaptation of the cones follows a relatively conventional course; but after exposure to light of longer wavelengths, the measurements at 436 mμ for the first 2 to 3 min exhibit the special characteristics of the violet receptor.

the primary sensation associated with this receptor is violet or blue (see *8*). It seems to us probably to be violet; and in certain ways to behave as a true primary. So, for example, when dark adaptation is measured with violet light following light adaptation in the orange-to-red, the threshold, when initially the violet receptor seems to be functioning alone, is usually reported as violet; but with the fall of threshold to the second cone plateau, marking the entrance of other types of cone, the threshold sensation commonly changes to blue. Examples are seen in the lower right-hand part of Fig. 2 and in the measurements at 405 and 436 mμ in Fig. 3.

Up to this point we have discussed the effects of adaptation with orange-to-red light. It is interesting to contrast these with the effects of blue-light adaptation. This is done in Fig. 5, which shows spectral sensitivity curves measured at 1 and 10 min of dark adaptation following light adaptation in the orange-to-red and blue. The curves for orange-to-red light adaptation are as in Fig. 4. After 1 min in the dark following blue-light adaptation, the sensitivity curve displays only the conventional cone maximum at about 555 mμ. The inflection in the violet region has been erased, which is added evidence that in the peripheral retina this is associated with the violet receptor rather than with the presence of an absorbing pigment. Just as the major effect of red-light adaptation is to spare the violet receptor, the major effect of blue-light adaptation is to depress its sensitivity. Yet significant differential effects are evident also at longer wavelengths. The spectral sensitivity curves measured at 1 min of dark adaptation cross at about 510 mμ; to the right of this point, the sensitivity is consistently higher following adaptation to blue light than following adaptation to red.

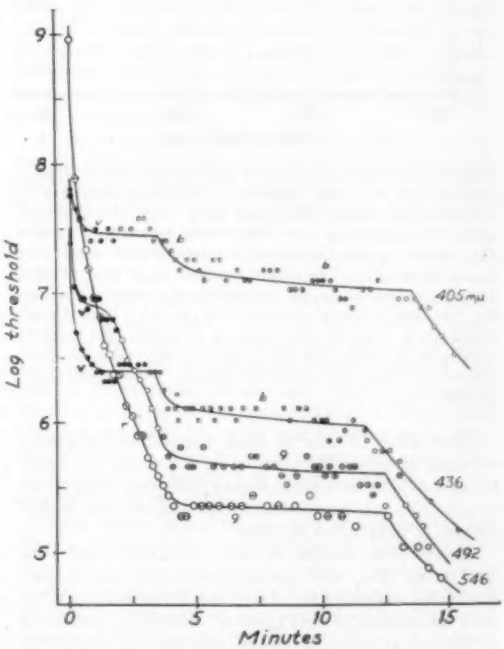


Fig. 3. Dark adaptation measured at four wavelengths following light adaptation in the orange or orange-red (log brightness, 5.87 or 6.14 millilamberts). Dark adaptation measured at 546 mμ is relatively simple in form; but the curves measured at 405, 436, and 492 mμ begin with the thresholds of the violet receptor and display special discontinuities for this reason. From such a family of curves, one may read off the thresholds at each wavelength at 1 and 10 min of dark adaptation. It is in this way that the curves shown in Figs. 4 and 5 were obtained.

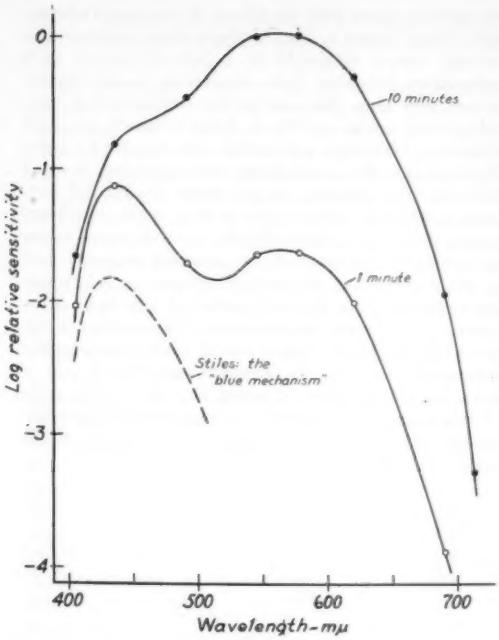


Fig. 4. Spectral sensitivity of cone vision measured at 1 and 10 min of dark adaptation following exposure to orange-to-red lights. Averaged data from seven normal observers, involving a 1° test field, centered 6° below the fixation point. Ordinates are log relative sensitivity (− log threshold). The curve obtained at 10 min of dark adaptation resembles the conventional photopic luminosity function, maximal at about 555 mμ. At 1 min of dark adaptation, however, the curve is bimodal; the primary maximum at about 436 mμ is that of the violet receptor. For comparison, the curve of Stiles's "blue mechanism" is shown also.

Even after 10 min of dark adaptation something remains of these distinctions. In the violet the sensitivity tends to be a little higher following adaptation to red light, whereas in the orange and red it is higher following adaptation to blue.

Experiments similar to those described have been performed also with protanopes and deuteranopes. Following exposure to intense orange or red light, the dark adaptation of both types of color-blind, measured at 621 mμ, is normal in shape, although the protanope thresholds are abnormally high, an expression of the subject's red-blindness. After exposure to orange or red light, dark adaptation measured at 436 mμ in both types of color-blind is simple in form and seems to involve the violet receptor alone. No such inflections and changes in color sensation appear as those that accompany cone dark adaptation in normal observers. Indeed, all our observations with protanopes and deuteranopes are consistent with the view that each of these possesses only two types of cone—the violet receptor and one other.

We have not yet had the opportunity to examine a tritanope. We have, however, made measurements in the central fovea of a normal observer, a region of the retina that has been characterized at times as "blue-blind" (*9*). Although genuine phenomena of great interest lie behind this characterization, they are not to be explained by the absence of the violet receptor, for this structure appears prominently in a 0.5° area of the central fovea as elsewhere in the retina.

References and Notes

* Hadassah research fellow in ophthalmology, from Hadassah University Hospital, Jerusalem.

1. W. S. Stiles, *Proc. Roy. Soc.* (*London*) B, **127**, 64 (1939); *Ned. Tijdschr. Natuurk.* **15**, 125 (1949); *Rev. opt.* **28**, 215 (1949).
2. H. de Vries, *J. Opt. Soc. Amer.* **36**, 121 (1946); also W. S. Stiles, *ibid.* **36**, 491 (1946).

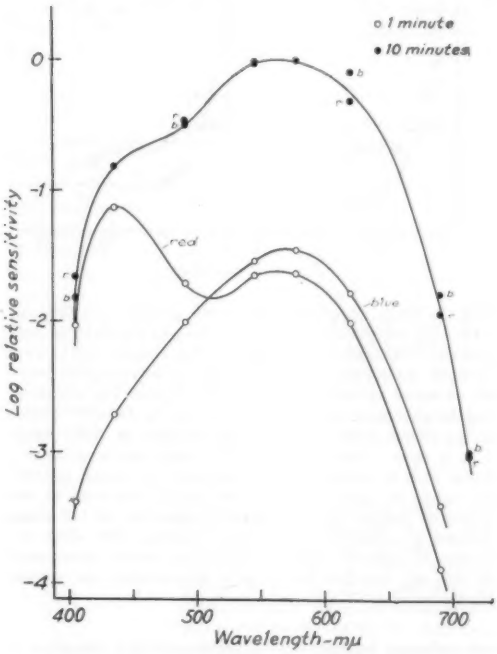


Fig. 5. Spectral sensitivity of cone vision measured at 1 and 10 min of dark adaptation, following exposure to orange-to-red or to blue lights. The curve at 1 min of dark adaptation after red-light adaptation displays the high peak at 436 mμ of the violet receptor, in addition to the lower, conventional photopic maximum. The corresponding curve after blue-light adaptation has the latter maximum alone; all evidence of the violet receptor has been erased. After 10 min of dark adaptation, both sets of data display the ordinary photopic maximum and also a shoulder at low wavelengths, a residue from the violet receptor. The 10-min curve also still exhibits signs of the differential effects of red- and blue-light adaptation: the sensitivity following red adaptation (*r*) tends to be higher at short wavelengths and lower at long wavelengths than following blue-light adaptation (*b*).

3. This investigation was supported in part by funds from the Rockefeller Foundation and the Office of Naval Research. We should like also to express our appreciation to the Institute for Advanced Study, Princeton, where this paper was written.
4. G. Wald, *J. Opt. Soc. Amer.* **35**, 187 (1945).
5. ———, *Science* **101**, 653 (1945); *Documenta Ophthal.* **3**, 94 (1949).
6. Stiles refers to a second "blue mechanism" which, in addition to the peak at about 435 mμ, is relatively sensitive throughout the remainder of the spectrum. This may represent the composite effect of the violet receptor and other types of cone discharging through the same optic nerve fiber.
7. A. König and C. Dieterici, *Z. Psych. und Physiol. Sinnesorgane* **4**, 241 (1892); reprinted in A. König, *Physiologischen Optik* (Barth, Leipzig, 1903), p. 214.
8. G. F. Göthlin, *J. Opt. Soc. Amer.* **34**, 147 (1944).
9. A. König, *Sitzber. deut. Akad. Wiss. Berlin* (1894), p. 577; reprinted in A. König, *Physiologischen Optik*, chap. 24; E. N. Willmer, *Nature* **153**, 774 (1944); E. N. Willmer and W. D. Wright, *ibid.* **156**, 119 (1945).

Social Implications of the Genetics of Man*

A. H. Sturtevant

California Institute of Technology, Pasadena

MAN is one of the most unsatisfactory of all organisms for genetic study. The time interval between successive generations is long, at best individual families are too small to establish ratios within them, and the testmatings that a geneticist might want cannot be made. Obviously no geneticist would study such a refractory object, were it not for the importance that a knowledge of the subject has in other fields.

One consequence of the difficulty of the material is that the exact mode of inheritance is known for very few of the differences among individuals. It is important that suspected cases be recorded, in order that other workers may check them; but there is an unfortunate tendency to accept such records as demonstrations rather than as suggestions. After examining some of the available published evidence, I am convinced that, even for some of the standard textbook examples, the evidence for the accepted mode of inheritance is far from conclusive—and that it would be recognized as at best suggestive, if any organism other than man were concerned.

There are enough unambiguous examples known to make it clear that the same principles are at work in man as in all other higher animals and plants—and even without such evidence, enough is known about the cytology of human tissues to give us confidence that no peculiar kind of inheritance is to be expected in man. In fact, much of the argument concerning the practical aspects of the genetics of man is best based on experimental evidence from other organisms rather than on what is known directly from study of human populations.

The position is especially unsatisfactory with respect to the heritability of the most important of all human differences—namely, mental ones. It would be possible to quote recent authorities for rather extreme positions on each side of this question. To some there appears to be no clear evidence for genetic differences in mental capacities among most individuals or among races, the observed mental diversity being attributed to environmental effects; to others the position is reversed—the environment accounts for little, genetic differences for nearly all the observed diversity. In these circumstances it is necessary to examine what direct evidence we have.

At the sensory level there is good evidence for inherited differences. There can be no question that such things as color-blindness, night-blindness, or sensitivity to the bitter taste of phenylthiourea are simply inherited; and one may confidently suppose that other such inherited sensory differences remain to be discovered. As has been pointed out by Blakeslee, we all live in different worlds by virtue of inherited differences in our sensory reactions to external stimuli. It should further be pointed out that these differences have effects at the highest mental levels. About 8 percent of white males are at least partially red-green blind; and when such a man looks at a painting he does not see what the artist put there or what other people see. It is clear that this simple and rather frequent genetic property has inevitable effects on the esthetic life of the individual.

These remain rather trivial sorts of differences; but there is another large class of inherited mental differences that is far from trivial. Certain types of severe mental derangement, such as Huntington's chorea or phenylketonuria, clearly have at least a large inherited element in their causation, although for most of them the exact method of inheritance may be regarded as somewhat uncertain.

However, what we are really most interested in is the vast array of differences lying between these extremes; and it is just here that the difficulty of the human material becomes most serious. When one is dealing with complex characters that vary more or less continuously in diverse respects, a genetic analysis is difficult in any material; in the case of man, a direct attack on the problem looks even more difficult.

One thing we want to know is: What portion of

* Presidential address at the Pacific Division of AAAS, Pullman, Wash., 22 June 1954.

existing mental diversities is of genetic origin and what portion is of environmental origin? Under these conditions the usual scientific procedure is to try to hold one variable constant, and then study the effects of variations in the other one. This can in fact be approximated in the problem of human mental differences, through the study of twins. Ordinary fraternal twins arise from the separate fertilization of two eggs and are no more alike genetically than are brothers and sisters that are not twins; but the environment to which they are subjected is likely to be more nearly the same. Identical twins arise from a single fertilized egg and are genetically identical. If one studies members of such pairs that were separated in infancy, any observed differences must be nongenetic.

The difficulty here is in the measurement of the properties we are interested in. Such studies of separated identical twins were begun by Muller and have been greatly expanded by Newman, Freeman, and Holzinger. I must confess to a feeling, however, that these studies tell us more about what the psychological tests used are really measuring than they do about the relative effects of heredity and environment.

There are then inherited differences in the sensory components of human mentality and also in components leading to severe derangements. In the area between these extremes the technical difficulties of getting clear-cut evidence are still unsurmounted. But it seems safe to conclude, from what we know of the genetics of complex characteristics in other organisms, that any property as complex and as variable as this must have a large amount of underlying genetic diversity.

This conclusion applies to individual differences. Analogy with other organisms leads likewise to the conclusion that there must also be at least statistical differences between racial groups. This is a rule that has held consistently wherever it has been tested—in many different kinds of animals and plants.

On general grounds, then, as well as from some direct evidence, one must conclude that there are inherited differences in mental properties among individuals and, at least statistically, among racial groups. But it is necessary to insist that one must not go beyond this point. Specifically, one must not conclude that a particular observed difference is genetically determined. It is, of course, a platitude to say that no one ever does anything for which he does not have the necessary genes; but one must never forget that there is also a necessary environment. It scarcely needs argument that human behavior is strongly influenced by economic status, tradition, and training. After all, most of the members of this society are in the business of teaching or, at least, have spent a good deal of time and energy pursuing academic work; we are therefore all of us witnesses to the obvious fact that men are teachable—that their behavior can be strongly modified by environmental stimuli.

This caution about attributing observed differences to genetic causes, rather than to environmental ones, applies with special force to comparisons among racial groups, for here the effects of tradition and of public opinion are especially strong.

Another thing that must be avoided is the view that one race (usually that to which one himself belongs) is "better" than another. All that can properly be concluded is that they are inherently different. It follows that society would do well to insure that as many people as possible, of as diverse racial origins as possible, get an opportunity to show what they can do to advance civilization. It may confidently be expected that individuals of various races will have the necessary genetic equipment to make unique contributions.

I wish to devote the rest of this paper to the effects of high-energy radiation on the genetic properties of man. This is a matter that has been of significance chiefly because of the use of x-rays for diagnostic and therapeutic purposes; but with the development of A-bombs and H-bombs it has become of far more general importance, for it is already true that all of us have been subjected to irradiation from these sources.

There are two possible types of radiation damage to be considered—damage to the exposed individual, and damage to the genes in his germ cells. The first will be more or less immediate in its manifestation, whereas the latter will have detectable effects only in future generations. This, however, is not the most basic distinction. Irradiation has a gross effect on tissues, resulting in the burns and other symptoms recognized as direct effects of heavy dosages; there is also an effect on the genes, leading to mutations.

The former, tissue effect, appears to be substantially absent at low doses, recovery from moderate effects is possible, and doses spaced well apart in time have little or no cumulative effects. It is on the basis of these effects that the "permissible" dose, to which it is supposedly safe to expose individuals, is calculated. But there is reason to suppose that gene mutations, induced in an exposed individual, also constitute a hazard to that individual—especially in an increase in the probability of the development of malignant growths, perhaps years after the exposure. There is, in fact, no clearly safe dosage—all high-energy radiation, even of low intensity and brief duration, must be considered as potentially dangerous to the exposed individual.

Let us now turn to the effects of irradiation on the genes in the germ lines of exposed individuals. Here again we are handicapped by the special difficulties of dealing with the genetics of man, for the quantitative determination of the genetic effects of irradiation requires much more refined techniques than are possible with man—a point that becomes obvious when one tries to evaluate the data available concerning the survivors of the Hiroshima bomb. There is sufficient evidence that quantitative results obtained with one organism cannot safely be applied to a wholly different kind of organism. However, there are certain general qualitative results that have now been so widely confirmed that we may confidently assert that

they apply to all higher organisms, including man. These results are

1) High-energy irradiation produces mutations.
2) The frequency of induced mutations is directly proportional to the dosage of irradiation. There is almost certainly no threshold value below which irradiation is ineffective.
3) The effects of successive exposures are cumulative.
4) The effects are permanent in the descendants of the affected genes. There is no recovery.
5) The overwhelming majority of these mutations is deleterious—that is, they seriously affect the efficiency of individuals in later generations in which they come to expression. These deleterious genetic effects may lead to early death or to any of a wide variety of defects, often gross ones.

There is a store of such undesirable genes already present in any population. What irradiation does is to add to this store.

It follows from these facts that any large-scale increase in the amount of irradiation to which human populations are subjected is a serious matter. Even though we cannot say that a given amount of irradiation will have a quantitatively specified effect, we can say that it will have some effect. The probability of an effect on the germ cells of any one individual may be very low; but when many millions of people are being exposed, it becomes certain that some of them will be affected. There is no possible escape from the conclusion that the bombs already exploded will ultimately result in the production of numerous defective individuals—if the human species itself survives for many generations. And every new bomb exploded, since its radioactive products are widely dispersed over the earth, will result in an increase in this ultimate harvest of defective individuals. Some such defectives would be present if the bombs had never been invented; the point is that the number due to the bombs will be added to this irreducible minimum.

Under these circumstances, I have been disturbed that Chairman Strauss of the Atomic Energy Commission should state, in an official press release from the White House, on 31 March 1954

> . . . it should be noted that after every test we have had, and the Russian tests as well, there is a small increase in natural "background" radiation in some localities within the continental United States. But currently it is less than that observed after some of the previous continental and overseas tests, and far below the levels which could be harmful in any way to human beings. . . . [*Bull. Atomic Scientists* **10**, 164 (May 1954)].

Presumably this statement is intended to refer only to immediate effects on exposed individuals; but, as I have pointed out, there are important other effects, less immediately apparent. Every geneticist familiar with the facts knows that any level whatever is certain to be at least genetically harmful to human beings when it is applied to most or all the inhabitants of the earth.

I do not wish to be understood as arguing that the benefits ultimately to be derived from atomic explosions are outweighed by the biological damage they do. It may be that the possible gains are worth the calculated risk. But it must be remembered that the risk is one to which the entire human race, present and future, is being subjected. I regret that an official in a position of such responsibility should have stated that there is no biological hazard from low doses of high-energy irradiation.

Byron Cummings, Archeologist and Explorer

BYRON CUMMINGS, twice acting president of the University of Arizona and director emeritus of the Arizona State Museum, died at his home near Tucson on 21 May 1954. A teacher for more than 50 years and the organizer of two university museums, he retired from the classroom in 1938 at the age of 78 and from museum administration 7 years later. In his 94th year, he was actively engaged with the day's work until a few months previous to his death.

Byron Cummings was born at Westville, New York, 20 September 1860, youngest of the seven children of Moses and Roxana (Hoadley) Cummings. The father, a Union soldier, was killed during the Civil War. Byron was graduated from Oswego Normal School in 1885 and received his A.B. from Rutgers College in 1889. Rutgers awarded him an A.M. degree in 1892 and an honorary doctor of science in 1924. He pursued graduate studies at the University of Chicago in 1896 and at the University of Berlin, 1910–11. His devoted service at the University of Arizona was recognized with an LL.D. in 1921.

A teacher of magnetic personality, Professor Cummings began his professional career at Syracuse High School in 1887 and as an instructor in Greek and mathematics at Rutgers Preparatory School, 1889–93. In the fall of 1893 he moved to the University of Utah as instructor in Greek and Latin. Two years later he was designated full professor and head of the department, a chair he held for the next 20 years. At Utah he served also as dean of men, 1905–15, and as dean, School of Arts and Sciences, 1906–15. In the latter year, with 16 other faculty members he resigned in protest against administrative policies. While resident in Salt Lake City Professor Cummings was an active participant in church and civic affairs. He was a member of the Utah State Park Commission, 1909–15 and as a member of the managing board, School

of American Research, Santa Fe, New Mexico, until 1952.

In 1915 Professor Cummings accepted an invitation from the University of Arizona to establish a department of archeology and to develop a state museum from the nucleus of zoologic and geologic specimens then on hand. He continued as head of the department and as director of the museum until he retired in 1938 with the title of director emeritus. During his 23 years on the university faculty he was also dean of the College of Letters, Arts, and Sciences, 1918–21; dean of men, 1918–21; and acting president in 1921 and in 1927–28. His tireless service in the crowded university hospital, day and night throughout the influenza epidemic of 1918, is still remembered by students of the period.

In Arizona and in Utah Professor Cummings was a leader in archeological exploration and in organization of local archeological societies. He led the Utah party that discovered Rainbow Natural Bridge on 14 August 1909 and those that discovered Betatakin, Inscription House, and other famous Arizona ruins now administered by the National Park Service. He was leader of the National Geographic Society expedition that laid bare the lava-covered pyramid of Cuicuilco, in the Valley of Mexico, 1924–25. His last major archeological contribution was at Kinishba, a great ruin on the Apache reservation, Arizona, excavation of which he began in 1931 and continued until June 1939. He restored part of the ruin and built a local museum, which he cared for until 1946 when, at the age of 86, he withdrew to give full attention to his writings. A partial bibliography appeared in *For the Dean*, a volume of essays by 22 former students then professionally engaged in anthropology, published in 1950 in recognition of his 90th anniversary. His latest book, *First Inhabitants of Arizona and the Southwest*, appeared 19 September, 1953 on the eve of his 93rd birthday.

A man of unusual warmth and understanding throughout his long career, Dr. Cummings drew people to him from all walks of life. Neighbors and faculty members, as well as university students, went to him for counsel. In a little volume, *Indians I Have Known* (1952), he reviewed a few of the friendships he had made among the Navajo and Apache. He was a fellow of the American Association for the Advancement of Science and a fellow or member of numerous other professional societies. In 1896 he married Isabel McLaury, who died in 1929. He is survived by his second wife, Ann Chatham, whom he married in 1947, and by a son of the first marriage, Malcolm B. Cummings.

NEIL M. JUDD
U.S. National Museum, Washington, D.C.

News and Notes

Some New Scientific Trends in Meteorology

A conference on the significance and possibilities of high-speed computing in meteorology and oceanography was held at the University of California in Los Angeles, 13–15 May. The conference, sponsored by the National Science Foundation was attended by about 40 scientists, including meteorologists, oceanographers, mathematicians, and fluid dynamicists. Most of the discussion of meteorological problems was concerned with the motions of the atmosphere. The fundamental laws of these motions are based on theoretical and experimental information available from fluid-dynamics studies, and they are applied with much success whenever the flow conditions are relatively simple, as is mostly the case in physics and engineering. However, in most meteorological problems, the fluid motions are extremely complicated and involve energies of relatively great magnitudes. The meteorologists have, therefore, of necessity been forced to build a new discipline, based partly on existing physical laws and partly on insight into atmospheric phenomena gained from long experience.

While the art of meteorology was thus being continually improved, important advances were being made in fluid dynamics and in pertinent mathematical techniques. Moreover, high-speed computing techniques came into being. With this newly acquired knowledge and facilities, a fundamental approach to problems of atmospheric motions has become possible. Electronic computing machines can now, within a reasonable time and without requiring thousands of human operators, apply such laws to many complicated meteorological problems. High-speed computing techniques can also be of assistance in testing those fundamental laws of physics that are not yet well established, and they can help in handling and analyzing the enormous amount of numerical data needed to describe atmospheric motions.

Numerical weather forecast, using high-speed computing equipment, is already an object of extensive studies, particularly in the United States and the United Kingdom. From known meteorological conditions over the United States, the general flow pattern can already be determined, 1 or 2 days ahead, for a large part of the country. Comparisons between the numerically determined charts and those observed 1 or 2 days later appear to be encouraging. With further scientific development, predictions of large-scale flow patterns, located correctly within, say, 200 mi will be made on a routine basis. The next step will be to connect with each flow pattern smaller scale motions combined with humidity and temperature fields and to

predict the weather on a scale at which it affects living conditions. The trajectories and development of tropical cyclones are being investigated in Japan. Some basic work has been done on tornadoes and hurricanes. Numerical forecast of the meteorological conditions leading to disastrous floods has been proved to be possible. These and other purely meteorological problems are of major importance in certain areas, and their further studies await the scientific development now made possible.

The study of the relationship between large-scale patterns and the smaller-scale phenomena, which is our local weather, must be based on a better knowledge of the atmospheric processes. Such knowledge can be acquired from extensive atmospheric data obtained under various meteorological and geographic conditions. However, the enormous amount of available data and their extreme complexity make it practically impossible for a meteorologist to digest them and to grasp fully their significance. A great many already available measurements therefore, remain unexploited; other significant meteorological data are not even collected, because of the time and labor required to analyze them. High-speed computing techniques now make possible the analysis of these data and their availability to the scientist in a usable form.

In most fields of science the use of electronic computors speeds up our knowledge and its technologic application. There is, however, an even more significant contribution of these machines, which is of particular importance to the future of meteorology. In such problems as weather prediction, the meteorologist does not even find time to apply all the laws that are already known. He, therefore, makes a general diagnosis of the meteorological situation and determines his forecast on its basis. There is, in such a prediction, some guessing in which experience is necessary and where some luck is helpful. No two human forecasters will reach precisely the same conclusions. A computing machine has the objectivity of an unimaginative mathematician; it will not guess, but it will give numerical solutions of the problem by applying the laws of physics. An incorrect forecast will indicate to the meteorologist how his instructions to the machine should be improved. The meteorologist will be able to determine his weather predictions on the basis of much more objective information.

Oceanography is expected to be advanced by high-speed computing techniques, although for the moment only some problems should be studied by these methods. Electronic computors can be also used with profit to study the interaction of the wind and sea motion and to extend the present calculations of the dynamics and energy dissipation of tides.

Atmospheric pollution of an industrial area has now become a major problem in many communities. Such areas face the problem of reducing the degree of contamination without detriment to many of those human activities that produce it and are necessary to the well-being of the population. Here again high-speed computing methods will make possible the application of the laws of physics to the solution of a large part of the problem. Using meteorological data, one will be able to determine the distribution of contaminants originating at each of the sources of pollution in the area. The relative contribution of each of the pollution sources to a possibly dangerous contamination, under various meteorological conditions, can then be determined. It may then be possible to use electronic machines to predict the contamination patterns and to protect the population when the meteorological conditions may become particularly dangerous. Atmospheric pollution studies become even more important with the development of nuclear energy, which is responsible for radioactive contamination.

The conference steering committee had the following membership: J. von Neumann, chairman (The Institute for Advanced Study); F. N. Frenkiel, secretary (The Johns Hopkins University); J. Kaplan, local member (University of California, Los Angeles); C. Eckart (Scripps Institution of Oceanography); B. Haurwitz (New York University); G. P. Kuiper (Yerkes Observatory); H. K. Stephenson (National Science Foundation); and H. Wexler (U.S. Weather Bureau). The local conference committee from the University of California, Los Angeles, was composed of L. M. K. Boelter, M. R. Hestenes, J. Holmboe, V. O. Knudsen, and R. R. Revelle.

FRANCOIS N. FRENKIEL

Applied Physics Laboratory,
The Johns Hopkins University

Acoustics and the Structure of Liquids

A conference on acoustics and the structure of liquids was held 20–21 June in the Ultrasonics Laboratory of Brown University under the sponsorship of the National Science Foundation. The meeting was attended by 35 experts from the United States, Belgium, Germany, Great Britain, India, and Italy. The participants were accommodated on the campus, and the arrangements thus included not only the presentation of scheduled papers but, more important, free and informal discussion of all points raised. For convenience, the regular sessions were assigned to four broad areas: compressional and shear waves in liquids; acoustics and chemical reactions; sound waves and theories of liquids; and gas nuclei and cavitation.

The structure of the liquid state has long been a challenge to both theorists and experimentalists. With the advent of precision ultrasonic equipment, it has become possible in recent times to make measurements of sound velocity and absorption coefficients over wide ranges of frequency and intensity and, through the medium of relaxation theories, to learn by acoustic means a good deal about liquids of all kinds at all temperatures and pressures. Many fascinating properties of liquids are associated with cavitation, and here again acoustics provides the most adaptable tool for their study. These and numerous other matters were taken up in detail in the conference.

At the first session, presided over by A. van Itterbeek of the University of Louvain, Belgium, John

Lamb of the Imperial College of Science and Technology, London, reported on an ingenious use of acoustic streaming produced by ultrasonic radiation to measure the sound absorption coefficient for frequencies in the neighborhood of 1 Mcy/sec of certain organic liquids like nitrobenzene, alcohol, and cyclohexane. He employs Poiseuille's law to measure the streaming velocity in a small-diameter side tube in parallel with the main ultrasonic radiation tube. The evaluation of the absorption coefficient is then carried out by assuming that it is proportional to the streaming velocity and using a standard liquid for calibration purposes. Lamb estimates the precision of this method as 5 percent or better. The method may have an important influence on future absorption-measurement techniques at relatively low frequencies.

At a subsequent session there was a great deal of discussion of the relationship between streaming and absorption. Carl Eckart of the Scripps Institution of Oceanography described his recent thinking on this problem and expressed the opinion that the well-known theoretical result that makes the streaming velocity proportional to the *total* absorption regardless of its origin (viscosity, thermal or structural relaxation, and so forth) is really only an approximation and would not hold, for example, in the case of chemical reactions taking place in a liquid near a solid obstacle. This conclusion was seriously questioned by several present, notably A. W. Nolle of the University of Texas and P. J. Westervelt of Brown. This important problem is clearly one that demands further careful study.

Other absorption studies by Karpovich at the Imperial College in London were reported by Lamb. These related to cyclohexane derivatives, the molecules of which show two-state configurational relaxation processes at relatively low relaxation frequencies. For example, methylcyclohexane has a relaxation frequency of 100 kcy/sec. The reverberation-time technique was used in these measurements, which clearly show an interesting use of acoustics as a tool in the study of the structure of organic molecules in the liquid state.

D. Sette of the Istituto Nazionale di Ultracustica in Rome presented a summary of the latest results obtained in his laboratory on absorption in binary mixtures of organic liquids. The results appear to confirm the presumption that, unlike the situation in associated liquids (for example, water and the alcohols) for which structural relaxation accounts rather well for the excess absorption over the classical (shear viscosity) value, for unassociated liquids the relaxation is largely thermal in origin, although in mixtures some molecular association may well be involved.

No discussion of the acoustics of liquids would be complete without a consideration of liquid helium. A. van Itterbeek, in reviewing recent work on the absorption in liquid helium II, indicated that the two relaxation frequencies detected at 1.4°K support to a certain extent the Landau theory of phonons and rotons.

Continuing the discussion of velocity and absorption in liquids, T. A. Litovitz of Catholic University of America thought that more attention should be paid to liquids like glycerol, which manifest both shear and compressional relaxation but do not possess a single relaxation time. He has considered it useful to compare dielectric and acoustic relaxation for such substances, taking as an example propyl alcohol whose dielectric properties have been examined by R. H. Cole of Brown. There are some suggestive agreements in relaxation times but still enough disagreements to provide interesting puzzles, particularly with respect to the relationship between molecular behavior and shear and compressional viscous flow. Further measurements of velocity and absorption for such substances over a wide range of frequencies, temperature, and pressure are contemplated. Since a glass can be treated as a supercooled liquid, some measurements of attenuation and velocity in fused silica at very low temperatures reported by W. P. Mason of Bell Telephone Laboratories were of great interest and relevance. An absorption peak has been located at about 45°K that is attributed to a relaxation in sidewise vibrations of the oxygen molecules in the Si—O—Si bonds.

In a panel discussion on *acoustics and chemical reactions* for which S. Parthasarathy of the National Physical Laboratory of India served as chairman, L. Liebermann of the Scripps Institution of Oceanography developed a theory of ionization reaction in electrolytes to explain the well-known anomalous sound absorption of solutions like magnesium sulfate. The theory assumes the coordination of water molecules with the metallic ions. Although the picture appears qualitatively attractive, it leads to much larger values of the activation energy than can be accounted for by the observed attenuation coefficients. The presentation aroused much discussion among the chemists present.

Turning aside from the chemical reaction theory of acoustic absorption, V. Griffing of Catholic University of America considered the question of how chemical reactions are produced by ultrasonics. She gave a detailed account of experiments on the ultrasonic production of free chlorine in the reaction between water and carbon tetrachloride in the presence of dissolved gases like argon, oxygen, and nitrogen. The conclusion is that such chemical effects always need the presence of cavitation and are indeed gas-phase thermal reactions taking place in the cavitation bubbles. It was pointed out that although the actual temperature rise associated with sound intensity of 5 to 10 w/cm^2 in a homogeneous medium is only a few degrees Celsius, the adiabatic compression of small bubbles by the sound can lead to temperature increases of several hundred degrees. For gas bubbles of higher specific heat ratio, one would then expect greater yields and this is found to be the case. The viewpoint was also expressed that the luminescence associated with cavitation is chemiluminescence. The paper led to much discussion, primarily of experimental details.

The conference turned next to a consideration of *acoustics and the theories of liquids*, with H. Eyring of the University of Utah acting as chairman. J. Meixner of the Technische Hochschule in Aachen presented a survey of theories of acoustic relaxation. He divided these into three fundamental categories: (i) phenomenological, employing the usual hydrodynamic equations together with a dynamic equation of state of rather arbitrary character; (ii) thermodynamic, involving a set of equations for the rates of change of internal variables of the system expressed in terms of thermodynamic affinity functions; (iii) aftereffect, or hereditary, implying the assumption that the pressure of the fluid at time t depends on the density at all previous times (integral equation approach). Meixner held the opinion that the hereditary mode of description is the most general of the three, although K. F. Herzfeld of Catholic University disagreed with this view.

M. S. Green of the University of Maryland described a new statistical mechanical theory of irreversible processes in liquids with which, in principle, the fundamental transport quantities for liquids can be calculated. The work has not yet progressed as far as the detailed evaluation. There seems to be some question whether or not the theory can lead to a frequency dependent viscosity.

An attempt was made by S. J. Lukasik of Massachusetts Institute of Technology to account for the temperature dependence of sound velocity in liquids by a hole theory. The work is tentative, but it was shown that the required hole size and activation energy of formation are reasonable. Lukasik also discussed the effect on acoustic propagation of heterophase fluctuations near the freezing point of liquids. The hole theory was also invoked by A. W. Nolle to account for the effect of large hydrostatic pressure on ultrasonic absorption. He builds a structural relaxation theory something like Hall's but with the presence of holes forming one state of the liquid. The sults appear promising, although the theory was criticized by Lamb, who thought the experimental results could readily be attributed to thermal relaxation.

H. F. Eyring interjected a brief review of some recent attempts to describe the flow of complicated liquids like rubber and the polystyrenes by means of model networks made up of non-Hookian springs.

The final topic considered by the conference was *nuclei and cavitation*. Here perhaps the fundamental question was the nature of the nuclei on which gassy cavitation starts. E. Meyer of the University of Göttingen described experiments that appear to show that air adhering to fine solid particles is responsible for the onset of cavitation, which is here measured by the change in attenuation it causes; animated discussion and questioning followed this paper. A different point of view was presented by K. F. Herzfeld, who described the theory of the late F. E. Fox that the cavitation nuclei are genuine air bubbles whose persistence, despite surface tension, is attributed to the protection of a monomolecular organic layer or skin; from this view the cavitation threshold is the sound intensity just sufficient to break the skin, so that air or other gases can diffuse into the bubble and cause it to grow. This theory has not yet been thoroughly tested experimentally.

G. W. Willard described some recent experiments at Bell Telephone Laboratories that may have a bearing on the cavitation threshold. These concern the interesting ripples or crispations formed on the surface of a small water droplet set in vigorous vibration by a barium titanate cylinder. When the intensity reaches a sufficient magnitude, the crests of these waves pop off in the form of smaller droplets with the concomitant production of air bubbles inside the vibrating drop. The possible multiplication of bubbles by this process was stressed, with presumptive application to ultrasonic emulsification, fog production, biological cell destruction, and so forth. E. G. Richardson of Kings College, Newcastle-upon-Tyne (the chairman of the panel) commented on similar crispation phenomena associated with the large cavity formed when an object is dropped into water. M. Harrison of the David Taylor Model Basin reported on water tunnel experiments leading to ripple phenomena of similar character.

M. S. Plesset of California Institute of Technology gave an engineering slant to the discussion by describing experiments in his laboratory on the growth of bubbles in superheated water. He also showed high-speed pictures of the collapse of cavitation bubbles in investigations directed toward a study of cavitation damage. I. Rudnick presented a summary of the recent studies by W. J. Galloway of the University of California at Los Angeles on cavitation threshold as a function of air content, hydrostatic pressure, temperature, and surface tension. This material is scheduled to appear in the *Journal of the Acoustical Society of America* for September.

I wish to express my grateful thanks to my colleagues W. L. Nyborg and R. W. Morse for helpful assistance in connection with the arrangements for the conference.

R. B. Lindsay
Department of Physics, Brown University

Brazilian Congress of Chemistry

The 11th national meeting sponsored by the Brazilian Association of Chemistry was held in São Paulo, 4–10 July. The meeting was officially included in the 4th centennial celebrations of the city, and it was presided over by O. Bergstrom Lourenço of the University of São Paulo. More than 250 members attended, and their number was considerably increased by guests and visitors.

At the opening session Carlos Chagas, Jr., addressed the audience in the name of the National Research Council of Rio de Janeiro. He discussed the evolution and present status of science in Brazil, emphasizing the work of several pioneers and pointing out the difficulties that still have to be removed in order to

promote the more rapid and steady development of scientific research in the country.

About 100 papers were given before eight divisions: general inorganic and physical chemistry; analytic chemistry; organic and biological chemistry; agricultural chemistry; industrial and engineering chemistry; food, toxicological, and legal chemistry; history and chemical education; and industrial organizations and economics.

The meeting also included three symposiums. The first one dealt with special methods of analytic chemistry, and the topics discussed were spectrographic methods, microanalysis with special reference to the work of Fritz Feigl, use of organic solvents in inorganic analysis, and applications of polarography. The second symposium on basic materials for the chemical industry was devoted to a discussion of the needs and problems of the Brazilian fundamental chemical industry with respect to basic materials, such as nitrogen, caustic soda, sulfur, and cellulose. Finally, in the third symposium, attention was given to the role of petroleum in the organic chemical industry, to the preparation of azo dyes from gammexane residues, and to the chemical classification of proteins.

The highlight of the meeting was the presence of three distinguished foreign guests. Richard Klar of the University of Frankfurt, Germany, spoke on "Fundamentals of international planning of the chemical industry"; G. H. Dieke of The Johns Hopkins University talked on "Spectroscopic methods on isotope analysis"; and I. M. Kolthoff of the University of Minnesota discussed the "Fundamentals of emulsion polymerization." A fourth lecture was given by a local professor, P. Krumholz, on "The impact of molecular science on chemistry."

The Argentine Chemical Society was represented by a special delegate. The foreign scientists attended several sessions, and Kolthoff presided not only at the symposium on analytic methods, making interesting and valuable comments, but also at a 2-hr informal gathering that met to discuss problems of mutual interest, especially the recent progress in amperometric titrations and questions on the aging of precipitates.

A selected program of plant trips gave many an opportunity to visit a number of factories, laboratories, and institutions in the city and the surrounding area.

PASCHOAL SENISE
Universidade de São Paulo, São Paulo, Brazil

International Astronomical Union

The executive committee of the International Astronomical Union decided at its meeting in Liége, Belgium, in July that the general assembly in Dublin is to take place between 29 Aug. and 5 Sept. 1955. There will be two general symposiums at Dublin, one on a comparison of the large-scale structure of our galaxy with that of other galaxies and the other on nonstable stars. The former will be organized by a committee under J. H. Oort, and the latter by a committee under V. A. Ambartsumian, P. Swings, and G. H. Herbig. There will also be four joint discussions, each involving several standing commissions: (i) turbulence in stellar atmospheres, (ii) fundamental stars, (iii) solar flares, and (iv) image converters.

The executive committee discussed invitations for the 1958 general assembly from Belgium, the Soviet Union, and Poland, together with tentative invitations previously received from Argentina, South Africa, and Australia. The committee unanimously decided that it viewed with favor the invitation to Moscow in 1958 and instructed the general secretary to investigate, with the vice president, the possibility of making all necessary arrangements. The final decision will be made at the Dublin meeting. The president of the Union read a letter from the Assistant Secretary of State and then requested that the executive committee place on its books a tentative invitation to meet in the United States in 1961. He underlined the fact that this invitation would be made formal only if the United States Government could see its way to meet the essential requirement that all competent astronomers who are members of the Union would be welcome. This invitation was supported by the U.S.A. National Committee on Astronomy, by the National Research Council, and by the American Astronomical Society. The executive committee "unanimously decided to record that it is grateful for and interested in the invitation from the U.S.A. for a meeting in 1961."

Two new countries, Venezuela and Israel, were admitted to the Union, and several other countries are in the process of forming suitable organizations for affiliation with the Union in 1955.

OTTO STRUVE
Berkeley Astronomical Department, University of California, Berkeley 4

Science News

Fission bomb particles that fell to earth in New York State caused a 1000-yr **mistake in dating** the earliest inhabitants of the San Francisco Bay area. The confusion began in 1953 when Bert A. Gerow, Stanford University anthropologist, excavated some ancient Indian burials on the San Francisco Peninsula. He sent samples of wood charcoal from the prehistoric graves to Columbia University's Lamont Geological Observatory at Palisades, N.Y., for carbon-dating.

While the charcoal samples lay waiting in the Observatory's laboratory, bomb tests were taking place in the Nevada desert. Microscopic specks of radioactive debris that were blown into the air floated clear across the continent and landed on the charcoal samples in New York. The samples were duly processed, and the laboratory reported to Gerow that his find was approximately 2000 yr old.

Since artifacts and certain other characteristics of the burials indicated greater age, Gerow sent along another and larger sample that proved to be 1000 yr

older. The Columbia research workers explained that many samples that had been awaiting test at the laboratory in March 1953 had been contaminated by the "fall out" of atomic debris from the explosions in Nevada.

J. J. Ghosh and J. H. Quastel report in the 3 July issue of *Nature* that **narcotics**, at pharmacologically active concentrations, exercise large inhibitive effects on the total respiration of the stimulated nerve cell by suppressing that aspect of respiration which is potassium-sensitive and which is concerned with carbohydrate (or pyruvate) oxidation. Working with rat brain cortex *in vitro*, they found that the inhibitory effect of narcotics did not occur with resting, unstimulated nerve tissue, and they support the conclusion that narcotics act on the nerve cell by suppression of oxidative events, particularly those involved in glucose or pyruvate oxidation.—E. M. L.

A group of investigators at Yale University, working with laboratory animals, have discovered the sections of the brain that play an important role in feelings of pain and fear. By applying electrical stimulation to the hippocampal gyrus or the lateral nucleus of the thalamus, they have succeeded in motivating cats to learn things they normally would not do, such as turning wheels, and refraining from food even though hungry. The research was conducted by José M. R. Delgado, assistant professor of physiology and psychiatry; Neal E. Miller, James Rowland Angell professor of psychology; and Warren W. Roberts, assistant in psychology.

The cats learned their new habits as the result of special emotions created originally by electrical stimulation, stimulation that could be delivered to special areas by means of electrodes implanted by Delgado. These habits could be conditioned to external signals, like the tone of a buzzer or the flickering of a light. This is believed to be the first time that animals have been motivated to **learn habits by electrical stimulation of the brain.**

The week of 3–9 Oct. has been designated for the annual observance of **National Pharmacy Week.**

Starting salaries for inexperienced chemists and chemical engineers are approximately 5 percent higher today than a year ago, although the cost of living has gone up only 1 percent, reports a recent issue of *Chemical and Engineering News*. The median salary for chemists who received the bachelor's degree this year is $364 a month, as compared with $351 in 1953 and $325 in 1952. For chemical engineers with the bachelor's degree, the median starting salary has risen from $360 to $375 since last year; those completing a 5-yr curriculum for a bachelor's degree are now receiving a median salary of $395, whereas the median for 4-yr graduates is $374.

Starting chemists with the master's degree report a median figure of $416 as compared with $404 last year. Those with the Ph.D. degree show an increase to $550 from $525. Starting salaries for chemical engineers with the master's degree are up 5 percent from last year to $425; those with the doctor's degree have made the greatest gain—6.5 percent to a median of $575. The median starting salaries offered to women graduates is lower than that for men in all groups except chemists with the Ph.D. degree.

Lloyd V. Berkner, operating head of Brookhaven National Laboratory and author of the State Department publication, *Science and Foreign Relations*, has written an appraisal of the general problems brought into focus by the Oppenheimer case. His article (*New Republic*, 12 July) is taken from a speech to the American Society of Chemical Engineers. In it he analyzes exhaustively and soberly the pros and cons of our present extremely tight security lid on technologic information. He also raises the question of whether our present **personnel security clearance system** may not be conditioning scientists to

> . . . avoid contact with any idea that may lead to military application. . . . Scientists are no different from anyone else in desiring to protect their reputations. Once they are involved in secret matters, their reputations may be destroyed by any person who makes irresponsible charges. . . . Clearance is not a permanent status, and a scientist's reputation is constantly susceptible to multiple jeopardy. . . . During each clearance review his entire life comes under scrutiny, and any act of indiscretion that may have had no relevance to security at the time, may arise to damn him.

Berkner underlines the dangers of seeking 100 percent security 'by exclusion' in the following words:

> An important concept in science is no less important to our national security because it is produced by one who cannot be 'cleared' by the arbitrary application of security procedures. We must not forget that Hitler and Mussolini abrogated their right to the atomic bomb when they drove a few leading scientists from their shores because they couldn't be cleared according to Nazi lights. Scientific greatness always arises from diversity of thought, never from conformity. Since the security procedures that support technological secrecy inevitably put a premium on conformity, they tend to prevent our nation's realization of the very greatness that we seek.

William McFarland of the University of California at Los Angeles has reported that when **fish are drugged** with sodium amytal they can be transported more easily. Because drugged fish require less oxygen, 3 times as many can be carried in containers without increasing the death rate.

Fort Belvoir, Va., has been chosen as the site for an experimental, full-scale but small **nuclear power plant** to be designed and built jointly by the Army Corps of Engineers and the Atomic Energy Commission. The plant is the prototype of a "package" or transportable power reactor that is being developed

for use at remote bases, eliminating the need to transport bulky conventional fuels. The reactor, a pressurized-water type with a capacity of approximately 1700 kw, will be built of components transportable by air. Succeeding plants for remote bases are expected to produce heat for space heating in addition to electricity. The model will provide construction, operation, and maintenance data and will demonstrate capabilities and limitations of such a plant. In this project, competitive proposals are being sought for the first time on the development, engineering design and building of a power reactor.

The National Research Council's Committee on Cancer Diagnosis and Therapy has issued a necessarily inconclusive report on the controversial **Lincoln bacteriophage treatment for cancer** that drew national attention in 1951–53. The treatment was developed by Robert E. Lincoln and championed in the Congress by Senator Charles W. Tobey of New Hampshire, both of whom are now dead. The investigating committee arrived at no conclusions because Lincoln abruptly withdrew his cooperation and the planned clinical trials were never conducted. Lincoln died a few weeks afterward.

The report traces developments between 12 Oct. 1951, when the Veterans Administration asked the NRC what it knew about Lincoln and the treatment he was using in his Medford, Mass., office, and the physician's sudden death on 30 Jan. 1954. The statement describes conferences and correspondence on protocol to be followed in clinical trials, steps taken to gain the cooperation of participating institutions, and finally, the sudden and mysterious reluctance of Lincoln to continue with the program. The report states that

> During the inquiry, no attempt was made by the committee to assemble records of cancer cases treated with bacteriophages by Dr. Lincoln or others, or to duplicate investigations reported by the Massachusetts Medical Society. . . . Because the committee did not receive any supply of therapeutic agents or any scientific data on objective benefits following the treatment of cancer with these agents, it has not been possible to undertake clinical trials or to evaluate scientific evidence on the response of cancer patients to the bacteriophage therapy proposed by Dr. Lincoln.

A scientific expedition left recently to make studies in Iraq, Mesopotamian Turkey, Syria, Lebanon, and Jordan. There will be a major investigation of the site of Jarmo, the oldest known village. Data will be sought on the world of 7000 yr ago, when the first great revolution in human history took place. This is the period when man turned from food-gathering and cave-dwelling to agriculture and the settled village.

Robert J. Braidwood, professor of Old World archeology at the University of Chicago's Oriental Institute, is director of the expedition. Associates include Bruce Howe of the Harvard Peabody Museum; H. E. Wright, Jr., a University of Minnesota geologist; Frederick R. Matson of Pennsylvania State University; and Charles A. Reed of the University of Illinois. Other specialists in many branches of natural science will join the project during the winter.

Further information on the **whooping crane** [*Science* **120**, 205 (6 Aug. 1954)], as given by the *Canadian Weekly Bulletin* of 9 July, is that the cranes' summer nesting grounds are thought to be somewhere in northern Canada. However, even when wildlife officials have attempted to follow the birds north from Texas by airplane, the birds have disappeared in the vicinity of the 60th parallel. It is known that a small number of whooping cranes winter in Texas but, according to Max W. deLaubenfels in the *Wilson Bulletin* **66**, 149 (June 1954), another group is thought to winter in Mexico.

July 6 was the **centenary of the death of George Simon Ohm,** after whom Ohm's law in electricity is named, and the July issues of *Discovery* (**15**, 279) and *Naturwissenschaftliche Rundschau* (**7**, 283) carry essays commemorating this date. Ohm also discovered in 1843 the fundamental law of physiological acoustics. The ear hears a pure sound only if produced by a pure sinusoidal vibration without any harmonics; if a vibration is more complex, it can always be resolved into sinusoidal harmonics. It was Helmholtz who brought Ohm's work to the proper attention of physiologists, musicians, and physicists.—K. L. H.

Scientists in the News

George Nelson Aagaard, dean of Southwestern Medical School at the University of Texas since 1952, has been appointed dean of the University of Washington School of Medicine, Seattle. The post has been open since last fall when Edward L. Turner, first dean of the school, resigned to become secretary of the Council on Medical Education and Hospitals of the American Medical Association.

On 1 Oct. **Harold O. Bolz,** head of the general engineering department at Purdue University, will assume his new duties as the new associate dean of the College of Engineering at the Ohio State University.

Arthur B. Cleaves is on leave of absence from Washington University (St. Louis) until Sept. 1955 to serve as chief geologist for Manu-Mine Research and Development Co., Reading, Pa. He will continue as geologist for the Pennsylvania Turnpike Commission and also in his association with the Board of Consultants for the Tennessee Valley Authority.

Alexander D. Langmuir, chief epidemiologist of the Public Health Service's Communicable Disease Center in Atlanta, is head of the 86-man emergency medical force dispatched by President Eisenhower to assist flood-stricken East Pakistan. Reports indicate that 7 million persons have been left homeless or seriously

affected by the unprecedented floods. Chief concern of the Pakistan Government is the threat of major epidemics. Other members of Langmuir's group of experts are **William Clark,** assistant team leader, epidemiologist with the California State Department of Health; **James Coffey,** insect control officer, chief of disaster services at the Communicable Disease Center in Atlanta; **Donald Johnson,** assistant insect control officer, entomologist attached to the Division of International Health; **Kenneth C. Lauster,** general sanitation and water supply officer, sanitary engineer attached to the North Atlantic Drainage Basin office in New York; **Robert Shannon,** administrative officer, attached to the Foreign Operations Administration public health office in Cairo, Egypt.

Joseph V. Michalski, major, U.S. Air Force, has joined the staff of the Aero Medical Field Laboratory, Holloman Air Force Base, N. Mex., as chief, biodynamics branch. A former member of the faculty of Emory University, Dr. Michalski has just completed a 3-yr assignment at the Army Chemical Center, Md., that included two trips to Korea as a wound ballistics investigator.

Allyn C. Miller, former technical operations supervisor of the California Research and Development Co., has joined the staff of Stanford Research Institute as an assistant chairman of the chemistry department. He will supervise project work in the chemical, metallurgical, and ceramic engineering section as well as in air research.

Ronald Neal, former head of the chemistry department of Drury College, has become associate director of research of Hoffman-Taff, Inc., and its subsidiary Hoffman Laboratories, Inc., Springfield, Mo.

P. L. Patel, professor of botany and head of the division of agronomy and plant breeding at the Agricultural Institute and Experiment Station, Anand, Bombay State, India, is in this country for 6 mo under the Point IV program. During August he visited educational institutions in Mississippi.

The U.S. Court of Appeals has upheld the dismissal of **John P. Peters** as a security risk by the National Institutes of Health [*Science* **119**, 500 (16 April 1954)]. A professor of internal medicine at Yale and consultant to the Quartermaster Corps, Peters was cleared of loyalty charges by Federal Security Boards in 1949 and 1952. Then in 1953 he was dismissed as special consultant to NIH after a third hearing initiated and held by the Loyalty Review Board of the Civil Service Commission, on charges supported by unsworn testimony of unidentified witnesses.

Peter's suit for reinstatement was submitted without formal briefs or oral arguments, and the adverse decision was expected, but sought in order to carry the case to the Supreme Court. His case is considered similar to that of Dorothy Bailey, government employee whose dismissal was upheld by the Supreme Court in 1951. That decision was, however, a 4-4 tie, which allowed the adverse decision of the lower court to stand.

Eugene Roberts, formerly on the staff of the division of cancer research in the Washington University School of Medicine (St. Louis), has been appointed chairman of the department of biochemistry in the newly reorganized division of research at the City of Hope Medical Center in Duarte, Calif.

At the 102nd commencement exercises, Purdue University awarded the honorary degree of doctor of science to **N. W. Shock,** chief, section of gerontology, Baltimore City Hospitals, "in recognition of his outstanding contributions in the fields of physiology and psychology and for distinguished work in gerontology and public health."

E. Lester Smith, senior biochemist on the staff of Glaxo Laboratories, Ltd., England, who in 1948 discovered vitamin B_{12}, was presented with the Gold Medal in Therapeutics of the Worshipful Society of Apothecaries at a soirée held in London on 20 July. The citation, which was given by Sir Lionel Whitby, referred to Dr. Smith's "fundamental contribution in connection with vitamin B_{12}."

The University of Pennsylvania has announced that **Frank Bradshaw Wood,** associate professor of astronomy since 1950, has been appointed professor of astronomy and director of observatories. Dr. Wood thus becomes head of the department of astronomy, succeeding **Charles P. Olivier,** who retired on 30 June.

Robert M. Yerkes has been awarded the Gold Medal of the New York Zoological Society. Fairfield Osborn, president of the Society, described Dr. Yerkes as "a true pioneer in comparative psychology and animal behavior whose lifetime work in this field has justified his title as Dean of Comparative Psychology."

Meetings

More than 5000 public health workers from all parts of the world will attend the 82nd annual meeting of the **American Public Health Association** and 38 related organizations in Buffalo, N.Y., 11–15 Oct. Approximately 400 speakers will present papers at 75 scientific sessions.

In a major action to increase the unity of the engineering profession, the **Engineers Joint Council** has adopted two important constitutional amendments permitting, under prescribed conditions, the admission of national and local organizations that do not at present meet all the qualifications for constituent membership. Conditions for admission are being drafted by a special committee. The council is made up of eight major engineering organizations with a total membership of 170,000. A membership of at

least 500 is required of a national organization to qualify and a constituent society, but the first of the new amendments permits the admission as associates of national organizations with less than that number of members. The second amendment permits the admission, as affiliates, of societies "which are regional rather than national in geographical scope." This amendment also permits the admission as affiliates of "federations of engineering societies (or of sections of such societies) broadly representative of the engineering profession in cases in which the majority of the societies who are members of the federation have qualifications for voting members equivalent to those required of constituent societies of the Council."

Eye specialists from all over the world will assemble in New York City 12–17 Sept. for the **17th International Congress of Ophthalmology** at the Waldorf-Astoria. This is the second time that this meeting has been held in the United States; the fifth congress convened in New York in 1876. More than 300 visitors are expected. Bernard Samuels and John H. Dunnington, both of New York, are president and vice president of the congress, and the host societies are the American Ophthalmological Society, the Section on Ophthalmology of the American Medical Association, the Association for Research in Ophthalmology, and the American Academy of Ophthalmology and Otolaryngology. Meeting concurrently for one session on 13 Sept. will be the International Association for the Prevention of Blindness.

The program for the congress will include about 150 papers, which will be presented by representatives of 30 countries. Two official subjects have been chosen, glaucoma and uveitis. Guest speakers on glaucoma will be Derrick Vail, Chicago; Rudolf Thiel, Frankfurt-am-Main, Germany; and G. P. Sourdille, Nantes, France. Those who will discuss uveitis are Allan C. Woods, Baltimore; Norman Ashton, London; and Vittoriano Cavara, Rome.

The Atomic Industrial Forum will hold a meeting 27–28 Sept. at the Plaza Hotel in New York City to explain to American industry the meaning of the new atomic energy law enacted by Congress recently. More than 20 experts on atomic energy from government, industry, labor, and the legal profession will describe to industrialists from companies all over the country how the government plans to implement the new law, what industry plans to accomplish under it, and what investment and insurance opportunities and problems are created by it. The new law for the first time will permit private industry to own atomic facilities, to have rights to atomic patents, to export atomic equipment, and to lease atomic fuels from the government.

The title of the meeting will be, "**The New Atomic Energy Law—What It Means to Industry.**" An address will be delivered by T. Keith Glennan, president of Case Institute of Technology and former U.S. Atomic Energy commissioner. He will describe "The New Industry-Government Partnership." Government spokesmen who will be present include Lawrence R. Hafstad, director of reactor development for the Atomic Energy Commission; William Mitchell, general counsel of the AEC; C. D. Luke, new director of classification for the AEC; and Corbin Allardice, executive director of the Joint Congressional Committee on Atomic Energy.

The **14th Pan American Sanitary Conference,** governing body of the Pan American Sanitary Organization, will be the guest of the Chilean Government during its 17-day session in Santiago in October. Meeting once every 4 yr, the conference, which also serves as the World Health Organization Regional Committee for the Americas, has the following items on its agenda: reports by the director of the Bureau, Fred L. Soper; the 1955 program and budget; consideration of the malaria eradication program initiated in 1954; health reports of member states; election of a director; executive committee nominations. There will also be a series of technical discussions in the form of seminars held concurrently with the conference session. The subjects chosen this year are (i) methods of improving the reliability of raw statistical data required for health programs; (ii) control of infant diarrheas in the light of recent scientific progress; and (iii) application of health education methods in rural areas in Latin America.

The **6th Southeastern Regional Meeting of the American Chemical Society** will be held at the Thomas Jefferson Hotel in Birmingham, Ala., 21–23 Oct. Divisional sessions are scheduled in analytical chemistry, biochemistry, chemical education, organic chemistry, physical and inorganic chemistry, industrial chemistry, and chemical engineering. Symposiums are planned on "Analysis and role of trace elements in plants and animals"; "Nitrogeneous carbohydrates and animal polysaccharides"; "Organic reaction mechanisms"; "Contributions of chemistry to dentistry and medicine"; "Process equipment"; "Pulp and paper technology"; "High school chemistry at the crossroads"; and "Applications of chromatographic methods of analysis."

The general meeting on 21 Oct. will be addressed by Gerard Piel, publisher of the *Scientific American,* and on 22 Oct. there will be a banquet with ACS President Joel Hildebrand as the featured speaker. Correspondence concerning the meeting should be addressed to the general chairman, Dr. Locke White, Southern Research Institute, Birmingham, Ala.

The **3rd Symposium on Temperature,** an international meeting sponsored by the American Institute of Physics, the National Bureau of Standards, and the Office of Ordnance Research, U.S. Army, will take place in Washington, D.C., 28–30 Oct. Attendance at the sessions, which will be held in the National Bureau of Standards, is open to all interested persons; the registration fee is $1. Advance registration by mail is requested if possible, in order that suitable facilities may be provided for the number attending.

Further information may be obtained from Wallace Waterfall, American Institute of Physics, 57 E. 55 St., New York 22, N.Y.

Publication of the symposium proceedings is being arranged by the American Institute of Physics in order to provide a companion volume to *Temperature, Its Measurement and Control in Science and Industry*, which is the record of the second symposium in 1939. The book is expected to appear by the fall of 1955, under the editorship of Hugh C. Wolfe of Cooper Union.

Allen V. Astin of NBS and Raymond E. Wilson of the Emerson Research Laboratories are chairmen of the general and program committees, respectively. The program is as follows.

General concepts: "General concepts of temperature and their limitations," H. C. Wolfe; "Concept of temperature near 0°K," F. E. Simon; "High gas temperatures," G. H. Dieke; "Astrophysical temperatures," C. H. Payne-Gaposchkin.

Standards and scales: "Gas thermometry," J. A. Beattie; "High temperature gas thermometry," J. A. Hall; "Precision resistance thermometry and fixed points," H. F. Stimson; "The zinc point as a thermometric fixed point," H. Preston-Thomas; "Low temperature scales," R. B. Scott (from 90° to 5°K) and R. P. Hudson (from 5° to .1°K); "Techniques of magnetic thermometry," H. van Dijk.

Transient phenomena: "Irreversible thermodynamics and fluctuations," I. Prigogine; "Relaxation of partial temperatures," K. F. Herzfeld; "Temperature in relation to flow processes," J. G. Kirkwood.

Experimental measurements: "Below one degree K," D. de Klerk; "Flames and hot gases," H. P. Broida; "Temperature measurement in engineering," H. J. Hoge; "Selected new methods," J. G. Daunt (superconductors as thermometers), S. A. Friedberg (semiconductors as thermometers), and D. R. Pardue and A. L. Hedrich (sound velocity as a measure of gas temperature).

Miscellaneous topics: "Temperature in shock waves," A. R. Kantrowitz; "Atomic explosions," F. G. Brickwedde; "Ionization measurement of high temperatures," W. Lochte-Holtgreven; "Temperatures in the upper atmosphere," H. E. Newell, Jr.

Education

A scientific center for **basic research in the field of neurology** is to be built just outside Caracas, Venezuela. The head of the new institute, Humberto Fernández-Morán, is a neurologist and cytologist who for 8 yr has studied and carried on advanced research in Sweden. The Venezuelan Government has already appropriated more than 3 million for the project, which is one of the largest of its kind in the world. The institute is to include 12 central departments and is planned as a training center for young scientists from the whole of Latin America. Leading specialists from all over the world will be invited as lecturers.

For many years **Brooklyn Polytechnic Institute** has offered a graduate course, "Introduction to powder metallurgy," by Henry H. Hausner. This fall the institute will add, for the first time, a second graduate course "**Advanced powder metallurgy**," in which Hausner will discuss the scientific fundamentals and solid state reactions in powder metallurgy.

The philosophy behind a new approach to public education is described in a booklet, ***The Ear of the Beholder***, by Margaret M. Farrar, published by the New York State Department of Mental Hygiene. In releasing the booklet Commissioner Newton Bigelow indicated that its purpose is to explain "why this department uses comic books, puppet shows, and similar media to teach the principles of good mental health." The report summarizes 5 yr of activity in a new educational program that attempts to reach the man on the street by speaking his language and using ideas he can grasp and accept.

From a small beginning only 2½ yr ago, a world center has been established at Indiana University for the **growing of algae**, a group of plants that suddenly has risen to a place of scientific and economic importance. Nearly 700 different strains of fresh-water algae are now under cultivation in the Indiana collection. These are distributed at moderate cost to colleges and industries for teaching and research.

The **shortage of technicians** in California medical laboratories is still critical, according to a survey by two staff members of the University of California School of Medicine, San Francisco. Ramona Greefkens, supervisor of field service of curriculum in medical technology in the School of Medicine, and James Hopper, supervisor of the curriculum in medical technology, report in the current issue of *California Medicine* that there is a 12.4-percent shortage of medical technicians in the 432 California laboratories surveyed. This is only a slight improvement over the situation 5 yr ago, when there was a deficit of 14.5 percent. The report suggested the stimulation of more interest in medical technology as a career, the establishment of apprenticeships in the fourth year of training, and more paid apprenticeships.

The **Union University School of Nursing** has announced a substantial reduction in its tuition, and also an administrative reorganization that is aimed at attracting more eligible young women to the nursing profession during this period of nurse shortage.

The **University of Michigan** has announced construction of a two-story building, so simple that it can be quickly erected, altered, or disassembled by workers equipped only with wrenches. To be known as the Research Laboratory of the College of Architecture and Design, the temporary structure requires weeks rather than months to build and is expected to cost less than a conventional building of the same size. It

will be bolted together in an area adjoining the Architecture Building. In the future it can be taken apart, moved to another site in compact bundles, and erected again.

Materials are being donated by the Unistrut Corp. of Wayne, Mich., sponsor of a research project under which the design of the laboratory was developed, and by other manufacturers. The university's Engineering Research Institute and the College of Architecture and Design planned the building, which embodies a new architectural concept—the Unistrut space frame system of construction—a method of introducing a third dimension of reinforcement to support the roof. Conventional roofs rest on beams or trusses running in two directions between walls; the space frame utilizes diagonal struts that permit stresses to be distributed in three directions.

Specialized equipment that will benefit newborn babies and small children will be purchased as a memorial to the late Jacob A. Danciger, assistant professor of pediatrics at the **University of Tennessee College of Medicine.**

West Virginia University expects to break ground this fall for the largest building in its 87-yr history—the 5-story, 1000-room Basic Sciences Building that will be the heart of the new Medical Center.

Available Fellowships and Awards

The **Cigar Manufacturers Association of America** recently announced that in order to expand its research program it will make additional grants available for studies in the genetics, biochemistry, and chemistry of cigar tobaccos. One of the purposes of these studies is to increase knowledge of the substances present in the leaves of cigar tobaccos, and of the chemical conversions that these substances undergo during the various stages of industrial processing and during the smoking of cigars. Applications for research grants should be sent to Mr. Charles H. Horn, Chairman, CMA Research Committee, Room 1321, 350 5th Ave., New York 1.

Entries are being accepted now for the **Oberly Memorial award** of $1200 made every 2 yr by the American Library Association for the best bibliography in the field of agriculture or the natural sciences. The current award, to be made at the ALA annual conference in Philadelphia next July, is for a bibliography issued in 1953 or 1954.

With a letter of submittal, four copies of the bibliography should be sent to J. Richard Blanchard, Librarian, University of California Library, Davis. *Final entry date is 15 March 1955.* Points to be considered in judging the bibliographies are accuracy, scope, usefulness, format, and special features such as explanatory introductions, annotations, and indexes.

Nominations are invited for the **Osborne and Mendel award** of $1000 established by the **Nutrition Foundation, Inc.,** for the recognition of outstanding accomplishments in the general field of exploratory research in the science of nutrition. It is intended for the investigator who has made the most significant published contribution in the year preceding the annual meeting of the American Institute of Nutrition, or who has published a series of contemporary papers of outstanding significance.

Normally preference will be given to workers in the United States and Canada, but investigators in other countries, especially those sojourning in the United States or Canada for a period of time, are not excluded from consideration. Membership in the Institute of Nutrition is not a requirement for eligibility and there is no limitation as to age. Nominations may be made by anyone; those for the 1955 award, accompanied by data relative to the accomplishments of the nominee, must be sent *before 1 Jan.* to Dr. Floyd S. Daft, Institute of Arthritis and Metabolic Disease, National Institutes of Health, Bethesda, Md.

The Future Scientists of America Foundation of the National Science Teachers Association has announced the 1955 program of **Recognition Awards for Science Teachers.** This program, now in its fourth year, is sponsored by the American Society for Metals. It is a cooperative attempt to recognize science teachers in elementary and secondary schools who have developed new ideas and are willing to share them with other teachers. Further information may be obtained from the foundation, 1201 16th St. NW, Washington 6.

Grants and Fellowships Awarded

The **Atomic Energy Commission** has announced the award of 70 unclassified physical research contracts; 7 are new and the remainder are renewals.

University of Chicago. C. A. Hutchison, Jr. Paramagnetic resonance absorption, $27,235.

Cornell University. F. A. Long. Kinetic and equilibrium salt effects, $10,778.

University of North Carolina. K. Knox. Preparation and properties of compounds of technetium and rhenium, $11,450.

University of Notre Dame. B. Waldman. Assistance in remodeling of electrostatic generator, $30,000.

Vanderbilt University. C. D. Curtis. Transfer of ORNL Cockcroft-Walton to Vanderbilt University.

University of Virginia. F. L. Hereford. Interaction of polarized photons with matter and other research with a 1-mev Van de Graaff, $37,500.

University of Wisconsin. J. O. Hirschfelder. Quantum mechanical and semi-empirical determination of intermolecular forces, $19,500.

University of Arkansas. R. R. Edwards. Chemical effects of nuclear transformation, $36,500.

University of Arkansas. R. Edwards. Radioactivity of thermal waters and its relationship to the geology and geochemistry of uranium, $17,152.

Armour Research Foundation. D. J. McPherson. Heat treatment of zirconium base alloys, $24,800.

California Institute of Technology. R. F. Bacher. High energy physics, $375,000.

University of California. E. Parker. Creep of alloys, $58,700.

Catholic University of America. F. O. Rice. Production and identification of free radicals, $8568.

University of Chicago. H. C. Urey. Natural abundance of deuterium and other isotopes, $55,970.

University of Chicago. A. Turkevich and N. Sugarman. Nuclear chemistry research, $47,437; synchrocyclotron operation, $43,454.

University of Chicago. E. Fermi. Theoretical research in elementary particle physics, $40,203.

University of Chicago. S. K. Allison. Reactions of the light nuclei and the penetration of charged particles through matter, $39,839.

University of Chicago. L. Meyer. Structure and properties of graphite, $14,545.

Columbia University. W. W. Havens. Neutron spectroscopy and nuclear physics, $562,000.

Columbia University. H. H. Kellogg. Physical chemical properties of fused electrolytes, $23,500.

Columbia University. T. A. Read. Diffusionless phase changes in metals, $7000.

Duke University. H. W. Newson. Fast neutron cross-sections and shell structure, $89,633.

Emory University. W. H. Jones. Mass distriubtion in proton-induced fission, $5493.

University of Florida. D. C. Swanson. Electrostatic generator program, $8881.

Fordham University. M. Cefola. Formation of complexes by thenoyltrifuloroacetate and other chelating agents, $6640.

General Electric Company. J. H. Hollomon. Fundamental metallurgic research and development of zirconium base alloys, $137,000.

University of Illinois. F. Seitz. Experimental and theoretical investigation of radiation damage in solid materials, $95,284.

University of Illinois. H. G. Drickamer. Mechanism of molecular motion as determined from diffusion and thermal diffusion measurements, $16,140.

Illinois Institute of Technology. H. E. Gunning. Decomposition of molecules by metal-photosensitization, $16,000.

Illinois Institute of Technology. G. Gibson. Fundamental chemistry of uranium, $7000.

State University of Iowa. K. Kammermeyer. Separation of gases by diffusion through permeable membranes, $25,560.

State University of Iowa. N. C. Baenziger. Structures of intermetallic compounds, $7000.

University of Iowa. J. A. Jacobs. Nuclear structure, $34,800.

Johns Hopkins University. G. H. Dieke. Properties of nuclei, $28,019.

Kansas State College. C. M. Fowler. Precision beta ray spectroscopy, $7000.

University of Louisville. R. H. Wiley. Synthesis and properties of ion-exchange resins, $9498.

University of Michigan. E. F. Westrum, Jr. Low-temperature chemical thermodynamics, $12,420.

Michigan State College. M. T. Rogers. Physicochemical investigation of the interhalogen compounds, $15,840.

Michigan State College. H. Brubaker, Jr. Aperiodic oxidation states, $5000.

Michigan State College. J. L. Dye. Thermodynamic investigation of dilute solutions of the alkali metals in liquid ammonia, $4500.

University of Minnesota. J. H. Williams. 60-mev proton linac, $171,587.

University of Nebraska. T. Jorgensen, Jr. Mechanism of energy transfer of slow ions, $12,400.

Research Foundation of the State of New York. O. E. Lanford. Concentration of nitrogen-15 by chemical exchange, $10,138.12.

North Carolina State College. C. Beck (Loan) Use of fuel in operation of reactor.

North Carolina State College. F. P. Pike. Performance of contractors for liquid-liquid extraction, $22,537.80.

Northwestern University. E. N. Strait. Completion of 5-mev electrostatic generator, $52,390.

Northwestern University. F. Basolo and R. Pearson. Mechanism of substitution reactions of inorganic complexes, $6912.

University of Notre Dame. M. Burton. Radiation chemistry studies, $202,000.

Ohio State University Research Foundation. E. C. Mack, Jr. Separative processes, $34,164.

Ohio State University Research Foundation. J. G. Daunt. Nuclear paramagnetism and low-temperature physics, $23,800.

Ohio State University Research Foundation. J. N. Cooper, Nuclear spectroscopy and stopping power measurements with 2-mev Van de Graaff, $20,000.

Ohio State University Research Foundation. C. H. Shaw. Soft x-ray spectra of metals and alloys, $6500.

University of Oklahoma Research Institute. J. R. Nielsen. Spectroscopic properties of fluorocarbons and fluorinated hydrocarbons, $9311.

Princeton University. J. Turkevich. Temporary and permanent effects produced by radiation on solids, $8500.

Purdue Research Foundation. T. DeVries. Polarographic studies in nonaqueous solvents, $4000.

Rice Institute. T. W. Bonner. Nuclear physics research, $66,528.

University of South Carolina. O. D. Bonner. Fundamental studies of ion exchange equilibria, $3024.

Stanford University. E. L. Ginzton. Limitations of electron linear accelerators, $168,000.

Syracuse University. B. P. Burtt. Mechanism of gaseous radiation chemical reactions and the chemical reactions of electrons, $10,500.

University of Tennessee. G. K. Schweitzer. Radiocolloids, $4750.

University of Texas. E. L. Hudspeth. Fast neutron interactions, $38,880.

Vanderbilt University. R. T. Lagemann. Precision beta ray spectroscopy, $5378.

Vanderbilt University. C. D. Curtis. Equipment loan contract.

University of Wisconsin. R. G. Herb. Nuclear research with electrostatic generator, $86,400.

University of Wisconsin. F. Daniels. Geochemistry of uranium and the recovery of uranium from low-grade ores, $52,000.

University of Wisconsin. J. E. Willard. Application of radioactive isotopes to chemical problems, $27,172.

University of Wisconsin. R. G. Sachs. Theory of light nuclei, $13,942.

University of Wisconsin. D. A. Lind. Inelastic scattering of fast neutrons, $8543.

Yale University. H. S. Harned. Diffusion coefficients of electrolytes and molecules, $14,904.

In the Laboratories

Arthur D. Little, Inc., industrial consulting and engineering firm of Cambridge, Mass., has signed a contract with the Foreign Operations Administration for a continuation of its industrialization **project in Egypt** under the technical cooperation program. This contract extends until June 1955 the cooperative project for the development of Egyptian industry that has been carried on by the firm since January 1953.

The Consolidated Uranium Co. plans to build a 500-ton-a-day uranium mill in the Temple Mountain area near Greenriver, Utah.

A sales development and technical service laboratory for the **Du Pont Co.'s** film department will be built in Wilmington, Del., at an estimated cost of nearly $1 million. The new laboratory will expand Du Pont's program of service to customers in applications and use of cellophane, acetate and polyethylene films, Mylar polyester film, cellulose sponges and sponge yarn, and cellulose bands. The program also includes exploration of markets for all film department products and investigation of industry's need for new types of films.

North American Aviation, Inc., has installed three very **large mufflers** at the International Airport in Los Angeles. They will be used in ground testing of F-100 Super Sabre planes, new craft capable of exceeding the speed of sound in normal level flight. The noise of the 10,000-lb thrust jet engines shatters eardrums, yet with the new silencers engines operating at full power are barely audible 250 ft away.

The U.S. Air Force has awarded the **Perkin-Elmer Corp.**, Norwalk, Conn., two contracts totaling $750,000 to cover the development and construction of three powerful optical tracking devices for guided missile observation. These devices will consist basically of telescopes, similar to those found in astronomical observatories, mounted on massive gun mounts much like the ones used on battleships.

A proposal by the **Vitro Corp. of America** to study chemical and metallurgical processing problems associated with nuclear power systems has been approved by the Atomic Energy Commission.

Miscellaneous

The April 1954 issue of the Indian medical journal *Antiseptic* is a greatly enlarged special number commemorating the golden jubilee of that publication. This monthly journal of medicine and surgery was founded in 1904 by U. Rama Rau, and this number pays special tribute to him and to his colleague, and late T. M. Nair. These two are among the most distinguished members of the medical profession that South India has produced.

Hans G. Schlumberger of Ohio State University, who is studying **cancer in parakeets**, has need of live parakeets with tumors and parakeets that have died from tumors.

The New York office of the U.S. Atomic Energy Commission's **division of raw materials** has been transferred to Washington, D.C.

The purpose of a booklet, ***Evaluating Blast Effects on Buildings***, prepared by the Armour Research Foundation of the Illinois Institute of Technology, Chicago, is to assist architects in the analysis and design of structures. It describes a method of measuring displacement of actual structure by analyzing the behavior of mass and spring of a building represented by a model building. The motion of the model indicates the motion under actual blast of an atomic bomb. Copies may be obtained from the foundation.

The Chemical-Biological Coordination Center of the National Research Council is interested in learning of other organizations who are now using or are planning to use their ***Method of coding chemicals for correlation and classification.*** This extensive code was devised primarily to permit the use of punched cards in the correlation of chemical structure with biological activity. Proof of the adaptability and versatility of the code is some 53,000 compounds now coded by the center. The center would like to know of the experience others have had in adopting the code for their own special needs and also would be glad to answer any questions. Please address all correspondence to Miss Estaleta Dale, Chemical-Biological Coordination Center, National Research Council, 2101 Constitution Ave., Washington 25, D.C. Copies of the code may be obtained from the NRC Publications Office for $1.50.

For the first time this year, the Civil Service Commission is conducting a **procurement campaign for physicians** to serve in all branches of the Federal Government. They are needed for duties which range from adjudication of disability claims to venereal disease control. The Children's Bureau, Civil Aeronautics Administration, and the National Institutes of Health are among the agencies calling for medical personnel. The Air Force and Army want civilian pathologists and specialists in industrial medicine. Elsewhere there are vacancies in research, pharmacology, medical editing, and bacteriology, as well as in clinical medicine and surgery.

A separate drive is under way for doctors to join the Panama Canal Service. Here the age limit is 45, except for applicants with veterans preference. There is no maximum age limit for any of the other positions. Salaries range from $5940 to $10,450. There will be no written examinations for any of the jobs, selection being based on candidates' records. Recent graduates who are at present serving internships are eligible to apply. Forms may be obtained from any post office or Civil Service regional office.

Necrology

Jessie G. Beach, 67, paleontologist for the Smithsonian Institution, Washington, D.C., 16 Aug.; **Joseph H. Bodine**, 58, head of the department of zoology at the State University of Iowa, Iowa City, Iowa, 23 July; **John P. Buwalda**, 67, authority on earthquakes, former president of the Seismological Society of America, professor of geology and retired chairman of the division of geological sciences at California Institute of Technology, Pasadena, 19 Aug.; **A. H. Graham**, 53, leader in gamma globulin inoculation, Montgomery, Ala., 18 Aug.; **Gustaf W. Hammar**, 61, former head of the physics department at the University of Idaho, developer of ektron detectors, and senior supervising physicist of the Navy Ordnance Division of Eastman Kodak Company, Rochester, N.Y., 19 Aug.; **E. C. L. Miller**, 86, bacteriologist, biochemist, and librarian emeritus of the Medical College of Virginia, Richmond, Va., 21 July; **Abram P. Steckel**, 75, electrical engineer, developer of the cold-rolling process in making steel, and president of the Cold Metal Process Company, Youngstown, Ohio, 19 Aug.; **Herbert E. Stein**, 70, author, specialist in surgical gynecology, and former professor at the New York Polyclinic Hospital, New York, N.Y., 22 Aug.; **Enoch F. Story**, 42, analytical chemistry investigator and professor of chemistry at the University of Maryland, University Park, Md., 24 Aug.; **George H. Taber, Jr.**, 64, engineer, developer of improvements in the process of petroleum refining, and retired president of the Sinclair Refining Company, Rye, N.Y., 20 Aug.

Book Reviews

Atlas of Exfoliative Cytology. George N. Papanicolaou. Harvard Univ. Press, Cambridge, Mass., 1954 (for the Commonwealth Fund). 9 chapters + bibliography + index. Plates. $18.

Papanicolaou's atlas, dealing primarily with cancer diagnosis in exfoliated cells, is an outgrowth of his pioneer studies on the reproductive physiology of mammals by means of his well-known vaginal-smear technique. As a result of many years of arduous study, it has been possible to determine the presence of malignancy in certain body organs by examination of their exfoliated cells. However, much of this information is to be found only in isolated publications. Accordingly, Papanicolaou realized the urgent need for an atlas that would bring together in both a descriptive and a pictorial manner all the pertinent information relative to the subject of exfoliative cytology, particularly as it relates to the study of cancer.

The text is relatively brief. It is clearly and concisely written and seems to include the essential available descriptive morphologic information for the identity of both normal and malignant cells. Frequent reference is made to the meticulously executed color plates of both normal and pathologic cells, which were made under the supervision of the author. Of the 36 plates, 24 are drawings and 12 are photomicrographs.

In addition to chapters on the collection and staining of exfoliated cells in smears and washings and on the diagnostic characteristics of both normal and malignant cells, the work includes chapters and plates on the following: female genital system, urinary and male genital systems, respiratory system, digestive system, pleural and peritoneal exudates, and the breast. Other miscellaneous plates are of histiocytic cells, cells related to pregnancy, cells affected by radiation, and multinucleated cells and mitotic figures of both normal and malignant cells. In addition to the references made to the plates, the author has provided descriptive information in the form of legends as well as a page or more of discussion directly related to the specific cells illustrated.

The manual's durably bound seven-ring loose-leaf format is attractive if rather bulky. In adopting this form of binding, Papanicolaou hopes that the atlas may be kept up-to-date by the addition of new material as it becomes available. No one knows better than he that, at present, our knowledge of exfoliative cytology is limited, but he nurtures the hope that someday this new branch of cytology may emerge as an independent morphologic science.

It seems appropriate to mention here that in a recent symposium on the "Value of exfoliative cytology in the diagnosis of cancer," and in various other papers by experts in this field [*Am. J. Clin. Pathol.* **24** No. 6 (1954)], credit has been given to Papanicolaou as the leader in the development of this area of study. It was further stated that exfoliative cytology has proved a valuable routine screening technique for the diagnosis of certain types of cancer. In addition, the need for more trained pathologists and technicians in this field was emphasized. Accordingly, no more significant or opportune contribution could have been made to this subject than this atlas, which will serve as an essential guide, not only for the training of students, but also for the diagnostician and researcher as well.

H. W. Beams
Department of Zoology, State University of Iowa

Physical Meteorology. John C. Johnson. Technology Press, M.I.T., Cambridge; Wiley, New York; Chapman & Hall, London, 1954. xii + 393 pp. Illus. $7.50.

In recent years meteorologists have realized that substantial progress in solving problems of synoptic weather analysis must come from further knowledge of the fundamental physics of the atmosphere. Research in government and university laboratories has emphasized this approach, and from such endeavors useful results have been and are forthcoming. This book assembles in brief readable form a summary of much of our present knowledge of the physics of the atmosphere.

Beginning with refraction of electromagnetic energy through the atmosphere, the first chapter discusses terrestrial and astronomical refraction, mirages, and radio ducts. This is followed by a discussion of scattering phenomena, polarization, visibility determinations, and visual range. Chapters 4 and 5 cover radiation processes of the atmosphere. The fundamentals and measurement of solar radiation, long-wave radiation, radiation transfer in the atmosphere, heat budget of the earth, eddy diffusion of heat, and heat transfer in the soil are included. The use of atmospheric radiation charts, and the Elsasser chart in particular, are described in detail. A working copy of the Elsasser chart is folded into a pocket inside the back cover. Chapter 6 describes the theory of major optical phenomena in the atmosphere. This chapter might better have followed the material on scattering and visibility.

The chapters on the physics of cloud and precipitation formation present the classical theories, the limitations thereof, and the recent contributions of Houghton and Bowen. The section on cloud-seeding is brief and to the point, discussing only the mechanisms that have been investigated. Recent advances in radar meteorology for study of atmospheric moisture content and distribution are included. The fundamentals of the earth's electric field, thunderstorm electricity, lightning, and sferics are described in Chapter 9. The concluding chapters cover the ionosphere, ozonosphere, and physical properties of the upper atmosphere. Based on recent upper air research, the author has incorporated methods of measurement and data

on temperature, density, pressure, and humidity to 100 km.

This is intended as a textbook for undergraduate courses in physical meteorology. For this purpose it should succeed. The material is well organized in spite of the wide diversity of topics it covers and is written in a readable manner. Following each chapter adequate references and source books are listed as well as several thought-provoking problems. The many figures deserve a special note of praise for their simplicity, originality, and unusual clarity. A list of symbols and an index are included.

Johnson has presented in condensed form the fundamentals of a wide range of subjects bordering on meteorology. The book is highly recommended, not only as a textbook, but also as a useful reference for the professional meteorologist.

DAVID K. TODD

College of Engineering,
University of California, Berkeley

Introduction to Chemistry. R. T. Sanderson. Wiley, New York; Chapman & Hall, London, 1954. 542 pp. Illus. $5.50.

This book may find a clientele among those who gained their science in earlier years and would like a readable book with a minimum of mathematics and detailed material, to bring them up to the current concepts of atomic, nuclear, and molecular structure, ionic effects, and other basic concepts of chemistry. In addition to the suggested use as a self-review for those who have been through the elementary chemical education process, this book can obviously serve as a guide for an elementary course, provided that suitable lectures and experiments accompany it so as to provide an adequate background for comprehension.

WALLACE R. BRODE

National Bureau of Standards, Washington D. C.

Organic Coating Technology. vol. I. Oils, resins, varnishes, and polymers. Henry Fleming Payne. Wiley, New York; Chapman & Hall, London. 1954. 674 pp. Illus. $10.

The subject material in this book and in volume II, which is in preparation, is the chemistry, manufacture, and practical application of modern commercial coating materials. Volume I deals with fundamentals of film formation, plasticizers, test methods, and the basic chemistry and general use of coating materials such as vegetable and marine oils, varnish resins, alkyds, ureas, melamines, rubbers, cellulosics, vinyls, acrylates, and silicones.

Payne's lucid discussion, which is on a theoretical basis, provides a solid foundation for students and technicians to delve deeper into their various fields. Reference is made in each topic to commercially available coating materials and suggested formulations. This type of information, which is a proper combination of the theoretical with the practical, is of great assistance to the technician who often is forced to work rather blindly with commercial coating materials of undisclosed chemical composition. Credit must be given to the manufacturers who have made it possible for the author to gain this clear understanding of the nature of their products. In a book of this scope, there naturally are unavoidable omissions under the various subjects discussed, but on the whole the necessary fundamental information is presented clearly and concisely.

In the preface, the author states that this book, together with volume II, is intended for students in paint courses and for new employees in the oil, pigment, and paint industries. In my opinion, this book, because of its broad theoretical and practical scope, is worth careful reading also by the experienced technician. Payne has written on this difficult and highly ramified subject with the skill and understanding of a highly successful teacher, which he has been for a considerable number of years at the Polytechnic Institute of Brooklyn.

It is hoped that the high standard and interesting presentation of this book will be continued in volume II.

MARTIN SALO

Cellulose Acetate Development Division,
Eastman Kodak Company

Chromium. A. H. Sully. Academic Press, New York; Butterworths, London, 1954. xii + 272 pp. Illus. $5.50.

Zirconium. G. L. Miller. Academic Press, New York; Butterworths, London, 1954. xviii + 382 pp. Illus. $7.50.

These two books are the first of a series on the metallurgy of the rarer metals. Future editions are planned for titanium, molybdenum, platinum and the metals allied with it, manganese and uranium.

The first of these, *Chromium,* describes the ores, production of ferro-alloys and pure chromium, physical properties, fabrication and mechanical properties, electroplating, chromizing, and the constitution and properties of chromium alloys. The chapters on physical and mechanical properties deal extensively with some of the problems associated with the development of room-temperature ductility in chromium—that is, impurity content and nature of applied stresses. The discussions of electroplating and chromizing are very complete with respect to both theory and practice. The last chapter, which deals with the constitution and properties of chromium alloys, is one of the best summaries of this subject that has appeared.

The second book, *Zirconium,* is a fairly complete collection of the latest information on this metal. The first three chapters describe the history, occurrence, consumption, use, and extraction from ores. The fourth chapter, dealing with the separation of hafnium and zirconium, is of special interest by virtue of

the expanding application of the latter in nuclear energy. Adequate coverage is given to the production of zirconium metal in Chapters 5–7. The iodide process and the Kroll process are described in detail and improvements in the Kroll process are reviewed.

Four chapters are devoted to the structure and physical and mechanical properties of zirconium and zirconium alloys. Considerable emphasis is given in the next two chapters to those very important properties of zirconium that determine to a large extent its application and technology—that is, its reaction with the common gases and its corrosion resistance. The chapter dealing with alloying, theory, and a description of the binary-phase diagrams should be especially valuable to researchers in this field because of its completeness. Chapters containing information on fabrication by melting, mechanical working, and powder metallurgy are impressive, since they make clear that a great deal of information has been collected about the technology of a metal that was relatively unknown 10 years ago. The final chapter describes the compounds of zirconium that may become important in high temperature applications, such as the nitrides, carbides, borides, and silicides.

These two books appear to be a very creditable start on the rather ambitious series on the "Metallurgy of the Rarer Metals." They should prove to be adequate textbooks for the student and valuable reference works for the research worker. The first, *Chromium*, is of special interest for workers in the field of high-temperature metallurgy, and the second, *Zirconium*, to those engaged in nuclear-energy research and development.

E. J. Boyle
Metallurgy Division, Oak Ridge National Laboratory

Basic Botany. An introduction to the science of botany. Fred W. Emerson. Blakiston, New York, ed. 2, 1954. xiii + 425 pp. Illus. $5.

Basic Botany is attractively (though conservatively) bound, is printed in clear type on good paper, and has an index, a glossary, and a table of contents. From the opening words of the preface to the more than 20-page large-type glossary, this book is a living testimony to the man who wrote it. Somehow, most of modern botany has been woven into a clear coherent story. Survey though it is, the book has a wholeness about it. The illustrations suggest an ingenious teacher who has learned to use simple close-at-hand examples that will be remembered after technicalities are largely forgotten. The book is patiently put together to serve the needs of the average student, the better than average, and the very slow. Each chapter begins with a few pithy remarks, followed by an outline of the most important points. Each one closes with a clearly written summary, which frequently includes stimuli to further thought and observation.

The author has learned how to catch attention with a homely analogy or with a simple story that has a real point to it. He begins his preface, for instance:

> A beginning student in the laboratory is learning to adjust his microscope. He turns his mirror until he has a clear white light; he mounts a small green object on a clean slide and places this on the stage; he sees only a greenish blur; he moves the coarse adjustment; the low-power objective begins to focus; and then, he sees something that is entirely new to him. The experiences of this young student rather closely parallel the history of botany.

No man can be all things; it is unfortunate that Emerson could not command the services of a better photographer. Many of the original illustrations are ingenious in conception, but few of them make as effective halftones as they should. It is one thing to get a clear photograph; it is quite another to produce crisp halftones that stand up off the page.

The book as a whole speaks of Emerson's familiarity with the material. It is too bad that his experience might not have been amplified at one or two points. The mentions of mitosis and meiosis sound as if the author had had long experience with prepared slides of onion root tips but had never been fortunate enough to observe fresh acetocarmine smears of *Tradescantia* at firsthand.

Edgar Anderson
Missouri Botanical Garden and *Washington University*

Relaxation Methods. D. N. de G. Allen. McGraw-Hill, New York–London, 1954. ix + 257 pp. Illus. $7.50.

Everyone who has comprehended the extent of the versatility and power of relaxation methods will be gratified by the appearance of a really first-rate textbook on the subject. The method of "systematic relaxation of constraints" ("relaxation," for short) is no longer new to engineers, mathematicians, and physicists; applications to many physical and mathematical problems have been described in the literature since 1935, and many students have been trained in the relaxation techniques. Nevertheless, most of the research has been concerned with extensions of relaxation techniques to new classes of problems, and the treatises on the method are devoted primarily to exposition of these extended applications. Teachers have felt a need for a book that concentrates on explanation of how to relax, in the sense of describing the basic operations and techniques and showing how to apply them in obtaining relaxation solutions.

This need is satisfied abundantly by Allen's book, which, although not lengthy (fewer than 250 pages of text), is the clearest exposition of relaxation methods to come to my attention. The author does not attempt to develop the theory leading to the particular physical problems used as examples or to make the book a complete reference but limits himself to explaining how to use relaxation techniques. Such singleness of purpose, combined with careful organization of material and considerable skill and grace in its exposition, results in a book of exceptional clarity and readibility.

The simpler applications of relaxation methods are

covered in detail, with a wealth of practical advice on procedure, accuracy, and so forth. A logical development leads gradually into topics of interest to the advanced relaxationist. Chapters on three-dimensional relaxation and nonelliptic boundary-value problems are significant contributions, since they have previously been available only in the periodical literature. Incidentally, the two chapters devoted to eigenvalue problems provide one of the best treatments of the topic known to me. Systematic organization and careful marking of subdivisions contribute to the clarity of the entire work.

The inclusion of problem exercises at the end of each chapter is an advantage. However, the provision of answers to the earlier problems that are not readily checked by substitution in the governing equations would probably have been helpful to the beginning student, who is not yet entirely confident of his powers.

It may be inferred that I am enthusiastic about this book. Such an inference would be entirely correct. I strongly recommend it to general reader, beginner, and advanced student alike.

CARL H. WALTHER

Civil Engineering Department,
The George Washington University

Applied Electronics. Truman S. Gray. Technology Press, Cambridge; Wiley, New York, and Chapman & Hall, London, ed. 2, 1954. xxviii + 881 pp. Illus. $9.

This is a large book, intended to provide a detailed first course in electronics. It leads the student through a great many details of electron ballistics, electron physics, vacuum tube characteristics, and basic circuits, and concludes with a chapter on modulation. A final chapter is added, almost as an appendix, to cover these same subjects insofar as they are related to the transistor. Thus the book ends at just about the point where it begins to cover the subject matter that might have been expected from its title.

A glance at the chapter headings would seem to indicate that the book is limited in scope. Actually, this is not true. The titles of the numerous "articles" into which each chapter is divided show that considerable material is included. Furthermore, on reading the text, one finds even more breadth, for many subsubjects are discussed briefly. The over-all final impression is that the book is really somewhere between a textbook and a handbook. The author seems to have had difficulty in reconciling our enormous knowledge of electronics fundamentals with his desire to discuss all their aspects.

The philosophy of the book is best described by a sentence in the preface:

> Attempt is made to point out all links in the chain of reasoning in order to avoid those gaps that are so easily spanned intuitively by experienced engineers, but are so disturbing to the careful but inexperienced student.

Some of my associates and I do not agree with this philosophy. Although it is some time since I was a student taking a first course in electronics, I remember that my interest was stimulated by just those gaps that I could not span intuitively.

The foregoing criticism does not mean that Gray has not written a very valuable book. It is certainly one that every professional man working in electronics or a related field should have on hand and should find extremely useful as a reference book. It should be particularly useful for clearing up those finer points of theory that arise in practical discussions, points that are often omitted from less complete textbooks.

The price is quite reasonable, considering its size and the number of diagrams included. On the other hand, it is a fairly substantial sum for a student to pay for a textbook. The printing, diagrams, and binding are up to Wiley's usual high standards.

JAMES HILLIER

Research Department, Melpar, Inc.

The Proteins. vol. II, pt. A. Hans Neurath and Kenneth Bailey, Eds. Academic Press, New York, 1954. ix + 661 pp. Illus. $14.

Unlike volumes IA and IB of *The Proteins,* which were concerned with the integration of general properties and methods, volume IIA deals with specific proteins grouped by natural occurrence, function, or chemical similarity. The aim remains "to present a comprehensive, integrated account of the chemical, physical, and biological properties of the proteins." This book contains nine chapters by 14 authors, most of whom are familiar because of their important contributions to research. Careful editing is shown by the restriction in subjects, the absence of duplication, and by cross reference to the preceding volume; but individuality in focus and treatment is not suppressed.

The first three chapters are at once among the best, of greatest general interest, and the lengthiest; they comprise half the book ("Nucleoproteins and viruses," by R. Markham and J. D. Smith, "Oxidizing enzymes," by T. P. Singer and E. B. Kearney, and "Respiratory proteins," by Felix Haurowitz and R. L. Hardin). These subjects afford latitude for development of the theme of the relationship among structure, function, and biological activity, which ineluctably is denied to authors on some group proteins. Recent advances in the study of nucleic acid structure are excellently described, and viruses are discussed critically from the physicochemical point of view. Oxidizing, but not iron-containing enzymes, are covered in a veritable monograph, with emphasis on the isolated enzymes rather than on metabolic pathways. The interrelationship between the physicochemical and physiological properties of respiratory proteins is thoroughly discussed with a notable appreciation of comparative biochemistry.

The fascinating subject of toxic proteins is considered by W. E. van Heyningen, whose greatest handi-

cap is the scarcity of material in this field. Milk and egg proteins are ably summarized in well-documented chapters by T. L. McMeekin and R. C. Warner, respectively. The success of physical and chemical methods in the study of the soluble proteins is to be contrasted with the failure when applied to the poorly soluble, heterogeneous, and dissociable seed proteins, as described by S. Brohult and E. Sandegren. The chapter on proteins and protein metabolism in plants is a somewhat unavailing but commendable attempt to apply modern knowledge of nitrogen metabolism to the less understood features of the metabolism of non-seed proteins.

The volume concludes with a lucid and timely evaluation of the changing viewpoint on protein hormones by C. H. Li. The subject and author index will appear in the second part of the volume, but the text contains almost 3000 complete references, some as recent as late 1953.

The prime virtue of this invaluable series, which will appeal to the expert and the beginner in proteins alike, is that it presents a unified, critical, authoritative, and up-to-date treatment of the whole subject in historical perspective with all desirable detail.

FRANK W. PUTNAM
Department of Biochemistry, University of Chicago

Principles of Biochemistry. A biological approach. M. V. Tracey. Pitman, New York–London, 1954. ix + 194 pp. Illus. $4.

This book introduces the reader to cellular biochemistry with a discussion of the large polymers that occur in all cells. It discusses thoroughly the biological approach to cellular reactions such as energy storage, presents the fundamental concepts of many biochemical reactions in cells of both plants and animals, and describes many known analogous cellular reactions in bacteriology. The reader is introduced to such subjects as growth, differentiation, and reproduction, but the material does not emphasize the biochemical aspects.

A thorough discussion of food supply to the organism is given in a chapter on "Specialization in relation to environment." A unique discussion of the different biochemical pigments is presented in Chapter 7. The biological aspects of transport and waste products of cellular reactions are discussed in two chapters. The last three chapters are concerned with energy metabolism. The biological approach is divided into phototrophes, chemotrophes, nectrotrophes, and biotrophes.

The subject matter in this small book is so broad that certain topics are only briefly mentioned. The book lacks references for the reader who is interested in learning more about particular items. It is to be recommended for students in advanced biochemistry. The author is to be complimented for his diligent choice of topics.

W. E. CORNATZER
Department of Biochemistry,
University of North Dakota School of Medicine

Miscellaneous Publications

Hearings on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946, pt. 1, held 10–19 May 1954, 560 pp.; pt. 2, held 2–18 June 1954, 597 pp. Joint Committee on Atomic Energy, Washington 25, 1954.

Directory of International Scientific Organizations. UNESCO, Paris, ed. 2, 1953 (Order from Columbia Univ. Press, New York 27). 312 pp. $2.50.

Statistics of Special Education for Exceptional Children, 1952–53. Biennial survey of education in the U.S.—1952–54. Chapter 5. Mabel C. Rice and Arthur S. Hill. Office of Education, Dept. of Health, Education, and Welfare, Washington 25, 1954 (Order from Supt. of Documents, GPO, Washington 25). 78 pp. 30¢.

Statement before the Special Committee to Investigate Tax Exempt Foundations, House of Representatives—83rd Congress. Rockefeller Foundation and General Education Bd., New York, 1954. 72 pp.

The Training Job and How to Meet It. International Correspondence Schools, Scranton 9, Pa., 1954. 24 pp. Illus. Gratis.

Rheological Properties of Certain Joint-sealing Compounds for Concrete Canal Linings. Div. of Building Research Tech. Paper No. 2. E. R. Ballantyne. Commonwealth Scientific and Industrial Research Organization, Melbourne, 1954. 28 pp. Illus.

Instrumentation. Patent Abstracts, No. 1. Prepared by Government Patents Bd. Office of Technical Services, U.S. Dept. of Commerce, Washington 25, 1954. 65 pp. $2.

Production of High-Btu Oil Gases from Crude Shale Oils. Interim rpt. E. B. Shultz, Jr., J. J. Guyer, and H. R. Linden. Inst. of Gas Technology, Chicago 16, 1945. 24 pp. Illus. $2.50.

Fossil Pit-Vipers (Reptilia: Crotalidae) of North America. Transactions, vol. 12, No. 3. Bayard H. Brattstrom. San Diego Soc. of Natural History, San Diego, Calif., 1954. 15 pp. Illus.

Taxonomy, Phases, and Distribution of Chortoicetes ***and*** Austroicetes. K. H. L. Key. Div. of Entomology, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia, 1954. 237 pp. Illus.

Drainage of the Cache Valley Lowlands. Bull. 368. Willard Gardner and Orson W. Israelsen. Agr. Expt. Sta., Utah State Agr. College, Logan, 1954. 13 pp. Illus.

Ottica Industriale. Domenico Argentieri. Ulrico Hoepli, Milan, Italy, ed. 2, 1954. 466 pp. Illus. L. 3000.

Preservation of Wood by Simple Methods. Bull. 581. Henry W. Hicock and A. Richard Olson. Connecticut Agr. Expt. Sta., New Haven, 1954. 66 pp.

Investigation of Microbarometric Oscillations in Eastern Massachusetts. Geophysical Research Paper No. 27. E. A. Flauraud *et al.* Air Force Cambridge Research Center, Cambridge, Mass., 1954 (Order from Office of Tech. Services, U.S. Dept. of Commerce, Washington 25). 62 pp. Illus.

Information. A list of scientific articles, April–June 1954. Quarterly, No. 6. Taylor & Francis, London, E.C.4, 1954. 24 pp. Gratis.

Bibliography of Interlingual Scientific and Technical Dictionaries (In English, French, and Spanish). UNESCO, Paris (Order from Columbia Univ. Press, New York 27). 178 pp. $1.75.

Renascence or Decline of Central Europe. The Sudeten German-Czech problem. Wilhelm K. Turnwald. Wolf & Sohn, Univ. Press, Munich, 1954. 89 pp. Illus.

Technical Papers

Fractionation of Human Serum Albumin Using Continuous Filter-Paper Electrophoresis

Daniel L. Larson and Robert Feinberg

Department of Experimental Immunology, Immunology Division, Army Medical Service Graduate School, Washington, D.C.

In the study of proteins, it is often desirable to obtain specimens of a high degree of purity. It has been repeatedly shown that protein preparations that fulfill the requirements for homogeneity by one criterion may not be homogeneous when tested with a different technique. One of the most sensitive tests for the immunological homogeneity of a protein is the gel-diffusion test. In this test, an antiserum is prepared against the material under investigation, and the antigen and antibody are permitted to react in a gel medium under certain standard conditions. In our laboratory, several lots of human serum albumin (*1*), prepared commercially by alcohol fractionation, were examined for homogeneity. The preparations appeared as a single component in the ultracentrifuge and as a single peak with moving boundary electrophoresis. Immunochemically, the preparations gave a smooth quantitative precipitin curve with rabbit antihuman albumin serum. When these lots were tested with the gel-diffusion technique, they were shown to have at least three components, and, in some cases, they had a minimum of six components.

Continuous filter-paper electrophoresis is particularly well suited for the separation of small amounts of mixtures of proteins (*2*). It is a gentle treatment that can be carried out in the cold, and it avoids extreme changes in *p*H and electrolyte concentration. The fractions so obtained can be quantitatively recovered. An important advantage over other techniques of boundary or zone electrophoresis is that, except for the initial contact of the proteins on the paper, the fractions are physically separated throughout the remainder of the run. This reduces to a minimum the interaction between dissimilar proteins. It is the purpose of this communication to report the use of continuous filter-paper electrophoresis for the fractionation of human serum albumin.

Electrophoresis. The large continuous filter-paper electrophoresis cell, developed by Durrum (*2*), was used for the separations. The filter-paper curtain used was Whatman No. 3MM, 18¼- by 22½-in. sheets, cut to provide 28 drip points at the bottom of the curtain. Veronal buffer was used at *p*H 8.6 and ionic strength of 0.05. Power supply was 900 to 1000 v with a current of 20 ma. The entire apparatus was placed in a cold room at 4°C.

Gel-diffusion technique. A modification of the technique described by Oudin (*3, 4*) was used. The final concentration of agar was 0.3 percent. Antiserum concentrations of 50, 25, 12.5, and 6.25 percent by dilution were used. Antigen concentration was 5 percent by weight. Diffusion tubes were 80 mm in length with an internal diameter of approximately 3 mm. Runs were made in a 26°C constant temperature water bath up to 8 days.

Albumin samples. Ten lots of human serum albumin prepared by alcohol fractionation for the American Red Cross were examined. Samples were diluted to 10 percent for electrophoresis and diluted to 5 percent for gel-diffusion tests.

A 10-percent solution of the human serum albumin was allowed to siphon over onto the curtain at the rate of 3 to 6 ml/24 hr and was collected in tubes at the bottom of the curtain. Under these conditions, the albumin was distributed over seven drip points near the center of the curtain at the end of the preliminary run. The samples collected from the drip points were dialyzed at 4°C against distilled water to remove the buffer. The dialyzed fractions were dried in vacuum from the frozen state, and the material was tested for homogeneity using the gel-diffusion test. Material from the leading drip points, containing several bands in the gel-diffusion test, was pooled and run over the curtain a second time under the same conditions. The final products collected from the drip points were dialyzed, dried in vacuum from the frozen state, and retested with the gel-diffusion technique.

The results of a separation of human serum albumin fractions using this procedure are illustrated in Fig. 1.

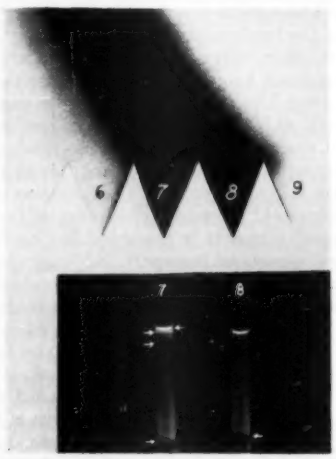


Fig. 1. Continuous filter-paper electrophoresis, second run, human serum albumin. Gel-diffusion tests on material obtained from drip points 7 and 8. Electrophoresis in veronal buffer, *p*H 8.6, ionic strength 0.05, 900 v, 20 ma, 4°C. Gel diffusion 25 percent antibody, 0.3 percent agar, 4 percent antigen, 25°C, 8 days.

Initially, there were four components in this lot of albumin when tested with the gel-diffusion technique. After the initial run, material from the leading three drip points, containing all antigenic components, was pooled, dialyzed, dried in vacuum from the frozen state, and run over the curtain a second time. As can be seen in Fig. 1, material taken from the leading drip point, No. 8, contained a single component; a specimen taken from the next drip point, No. 7, contained four components. The yield of the sample exhibiting a single band in the gel-diffusion test was of the order of 5 to 10 percent by weight of the original material.

It is possible that the final product contained minute amounts of the three other components present in the original material, since there are several recognized limitations to interpretation of gel-diffusion observations (*5*). For example, if the contaminating components were present in sufficiently low concentration, they could be present and still not give rise to a visible band in the gel-diffusion test. Similarly, it is possible that the single visible band represents more than a single antigen. This is unlikely, however, since these antigens would then have to possess the same diffusion rate and be present in similar concentrations, and the antiserum would have to contain homologous antibody at similar concentrations. The final product, representing 5 to 10 percent of the original material, may represent a serum albumin or, possibly, a protein with a faster electrophoretic mobility than serum albumin. It was apparent in the gel-diffusion test that the antibody to the purified material was present in relatively low concentration, but by the criterions we have available for purity, this product appears to be homogeneous.

References and Notes

1. Obtained through the courtesy of J. N. Ashworth of the American Red Cross and E. R. Squibb and Sons.
2. E. L. Durrum, *J. Am. Chem. Soc.* **73**, 4875 (1951); M. D. Paulik, *Can. J. Med. Sci.* **31**, 485 (1953).
3. J. Oudin, *Ann. Inst. Pasteur* **75**, 109 (1948).
4. J. Munoz and E. L. Becker, *J. Immunol.* **65**, 47 (1950).
5. J. Oudin, *Methods in Medical Research* (Year Book Publ., Chicago, 1952), vol. 5, p. 335.

15 April 1954.

Effect of High Fat Feedings on Viscosity of the Blood

Roy L. Swank

Division of Neurology, Department of Medicine, University of Oregon Medical School, Portland

Aggregation and adhesiveness of red blood cells were observed *in vitro* by Swank (*1*) and *in vivo* by Swank and Cullen (*2, 3*) to develop about 4 hr after fat feedings. They reached their maximum intensity 3 to 4 hr later and then subsided slowly to normal. The *in vivo* changes were observed in the cheek pouch of hamsters anesthetized with urethane, using the technique of Fulton, Jackson, and Lutz (*4*), and were recorded in colored motion pictures. The purpose of this report (*5*) is to show that significant increases in the viscosity of blood from the vena cava accompanies the aggregation and adhesiveness of red blood cells observed in the cheek pouch after fat meals.

Blood viscosity was measured by a method based on principles utilized earlier by Fahreus (*6*) and others, and developed for this specific problem (*7*). The time required for 0.1 ml of blood to flow through a standardized orifice at a negative pressure of 100 mm-Hg at 37°C gives a relative measure of viscosity that has proved fairly dependable. This time interval divided by the time required for the same amount of water to pass through the same orifice under the same conditions of temperature and pressure gives the viscosity of blood relative to that of water.

In the present experiments, the standardized orifice was a gage 25 hypodermic needle 1 in. long (vita). The tip of this needle with the bevel down was inserted into the abdominal inferior vena cava of the urethane anesthetized hamster. The negative pressure was applied by opening a stopcock on a 0.1-ml calibrated pipette to which the calibrated hypodermic needle was attached. The flow of blood was timed with a stop watch to 0.1 sec. It is essential in this type of determination that the tip of the needle inside the inferior vena cava be clearly visible; that the flow of blood in the pipette be smooth and steady; that the total time of the flow be less than 30 sec and preferably less than 20 sec; and that duplicate determinations that check to within less than 10 percent deviation be made. The hematocrits were determined on blood drawn from the vena cava into heparin immediately after the viscosity measurements (*1*).

A close correlation was first shown to exist between visible evidences of adhesiveness and aggregation of the red blood cells and an increase in the viscosity of the whole blood in nine hamsters fed a "normal" diet containing mixed grain, vegetable greens, and fox chow, and in 18 experimental animals 5 to 7 hr after being fed 1 to 3 ml of 35-percent cream (3 to 10 g/kg body weight) by stomach tube. Next the duration and extent of the viscosity changes after fat meals were determined.

Hamsters fed a diet containing about 50 percent of their calories as animal fat (*8*) for 5 to 7 days and then given a single fat meal of 2 to 3 ml of 35-percent cream almost always exhibited an increased viscosity of the blood. Animals so fed were anesthetized and their blood viscosities and hematocrits were determined 3, 6, 9, 14, 24, 48, and 72 hr after the single cream meals. The blood viscosity began to increase about 3 hr after the cream feeding and reached its peak in 6 to 9 hr (Fig. 1). During the first 9 hr only minor variations occurred in the hematocrit. The viscosity then returned to normal by the end of 24 hr. This was accompanied by a significant drop in the hematocrit. The hematocrit then returned to normal by the end of 72 hr, accompanied by a rise and then a fall of the viscosity to normal. The low hematocrit at the end of 24 hr is thought to be due to "sticking" of many of the red blood cells in the peripheral circula-

tion and to "plasma skimming," and the rapid return of hematocrit to normal in the next 24 to 48 hr is thought to be due to a return of these red blood cells to the active circulation.

The two viscosity measurements and the corresponding hematocrit determinations indicated by the arrows in Fig. 1 were high, and the general physical state of the two animals concerned was very poor. These values were therefore not used in the determination of the average hematocrit and viscosity values in the figure.

Gross inspection of the viscera of the hamsters revealed that the hamsters with elevated blood viscosity exhibited (i) much more than the usual degree of cyanosis of the venous blood, (ii) patchy or generalized hyperemia of the viscera, (iii) engorged prominent arteries along the curvature of the stomach and in the omentum, and (iv) a greatly reduced tendency to bleed from the vena cava puncture wound.

The addition of heparin *in vitro* in amounts sufficient to render the blood incoagulable (100 units/2 ml blood) reduced an elevated blood viscosity due to fat feeding to, or near to, normal (Table 1). Also, the injection of heparin intravenously in doses of about 400 units per hamster reduced an elevated blood viscosity after fat feeding and, at the same time, significantly increased the bleeding tendency from the puncture wound in the vena cava. In no instance was the viscosity reduced to normal and in all instances the effect of heparin *in vivo* was transient.

The maximum adhesiveness and aggregation of the red blood cells in hamsters occurs 2 to 4 hr after the peak of the plasma lipemia and lasts for several hours after the lipemia clears (*1–3*). It would appear that the maximum increase in the viscosity also occurs after the peak of the lipemia. The possible mechanism by which high fat meals cause aggregation and adhesiveness of the red blood cells has already been discussed (*1–3*).

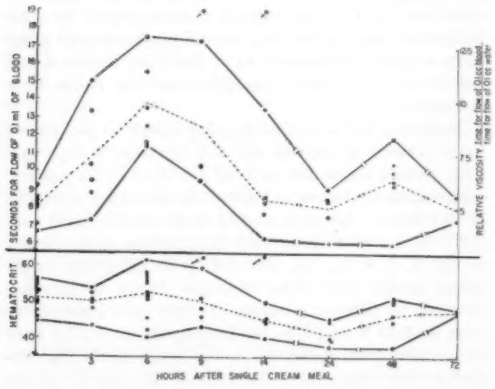

SECONDS FOR FLOW OF 0.1 ml OF BLOOD
RELATIVE VISCOSITY (time for flow of 0.1 ml blood / time for flow of 0.1 ml water)
HEMATOCRIT
HOURS AFTER SINGLE CREAM MEAL

Fig. 1. Changes that occur in the viscosity and hematocrit after a standard fat meal. Each dot for viscosity represents the average of two to three viscosity determinations in the same hamster. Solid lines: maximum and minimum values for viscosity and hematocrit; dashed line: average of all determinations for each time interval.

Table 1. Effect of *in vitro* heparin upon viscosity of the blood. Time in seconds for flow of 0.1 ml of blood.

From inferior vena cava	From syringe containing heparin		
	Immediately after withdrawal	5 min after withdrawal	After additional heparin
15.4	15.0	9.2	
16.0	15.0	9.0	
9.0	9.6	9.0	7.0
10.5	7.7	5.0	

If it is shown in human beings that large fat meals may be followed by aggregation and adhesiveness of the red blood cells with slowing of the circulation and an increase in the relative viscosity of the blood, it will be necessary to consider seriously whether this mechanism is a factor in human disease, particularly in chronic vascular and thrombotic diseases and in multiple sclerosis (*9*).

References and Notes

1. R. L. Swank, *Am. J. Physiol.* **164**, 798 (1951).
2. R. L. Swank and C. Cullen, *Proc. Soc. Exptl. Biol. Med.* **82**, 381 (1953).
3. C. Cullen and R. L. Swank, *Circulation* **9**, 335 (1954).
4. G. P. Fulton, R. G. Jackson, and B. R. Lutz, *Science* **105**, 361 (1947).

5. This study was started at the Montreal Neurological Institute, Montreal, Canada. It was supported jointly by grants from the Multiple Sclerosis Society of Canada and from the Department of Health and Welfare, Ottawa, Canada.

6. R. Fahreus, *Physiol. Revs.* **9**, 241 (1929).
7. R. L. Swank and J. Roth, *Rev. Sci. Instr.*, in press.

8. The high-fat diet was made from purina, whole-wheat flour, butter, and a mixed vitamin supplement.

9. R. L. Swank, *Arch. Neurol. Psychiat.* **69**, 91 (1951).

1 April 1954.

New Method for Study of Intracellular Parasites with the Electron Microscope

B. N. Dutta, N. N. Das Gupta, M. L. De, A. Guha, S. Nandi

School of Tropical Medicine and *Biophysics Division, Institute of Nuclear Physics, Calcutta*

Electron microscopic examination of parasites contained within an erythrocyte is difficult, because the red blood corpuscle itself is too thick for the penetration of the 50-kv electron beam. In the electronic image, the infected blood cell appears uniformly dense, within which the parasites cannot be identified. Several methods have been proposed for overcoming this difficulty. The first is to subject unfixed cells to osmotic hemolysis in distilled water (*1, 2*). Another method is to make ultra-thin sections suitable for electron microscopy, either by means of special microtomes (*3*) or by splitting of specimens (*4, 5*).

We wish to report a method (*6*) that is suitable for routine use and is much easier to use than the method of ultra-thin sectioning. This method has been used for the electron microscopic study of malarial parasites contained within the red blood corpuscle.

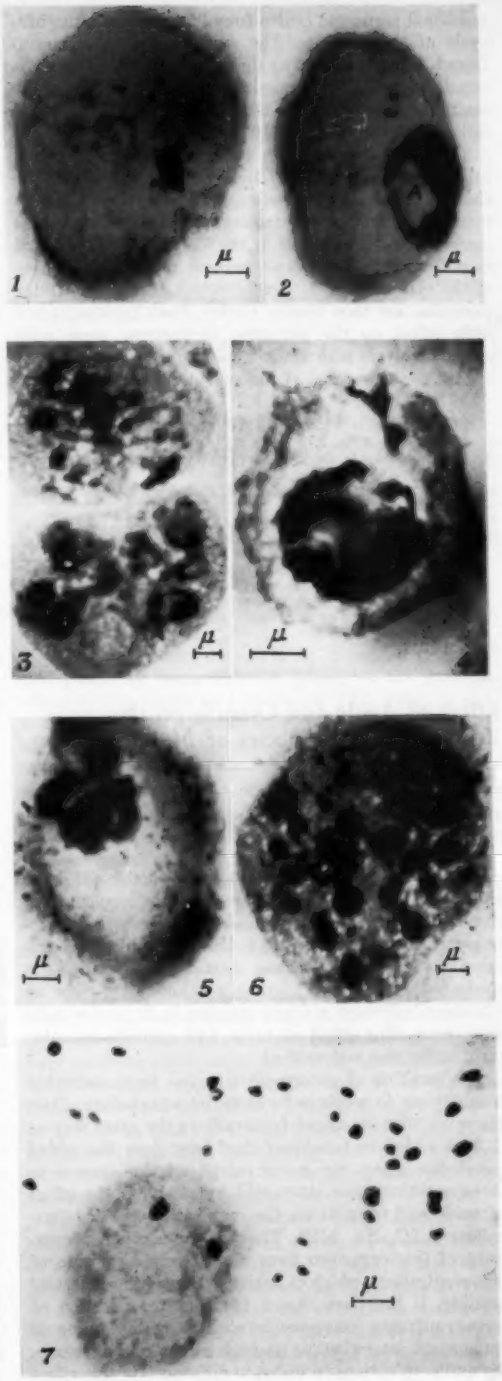
In this method, infected blood is first smeared on collodion-coated glass slides which are fixed subsequently by exposure to the vapor of 2 percent OsO_4 solution for 3 min. The slides, after a careful wash, are hydrolyzed in normal HCl at 60°C for 10 min and then again washed in distilled water. After the slides are thoroughly dry, the collodion film with the hydrolyzed smear of blood is stripped from the glass and mounted on steel mesh for examination under the electron microscope.

Some of typical electron micrographs of *Plasmodium berghei* obtained by this procedure are reproduced in Figs. 1 to 7. They were made with a 50-kv electron microscope assembled in the Institute of Nuclear Physics, Calcutta (*7*).

Figure 1 shows an early trophozoite stage with double infection. One of the parasites, *A*, is of ring form with a dense chromatin bead situated on a faint ring of cytoplasm, measuring 1.2 μ in diameter. A faint dot, caused possibly by the fragmentation of the chromatin, is visible at the other end of the incomplete ring. The mass density of chromatin is considerably greater than that of the cytoplasm. A late trophozoite stage is shown in Fig. 2, where a large fleshy form has developed. In many cases at this stage, the infected corpuscles are found to be multiply infected with a few parasites showing double chromatin (Fig. 3*A*).

The schizont stages are shown in Figs. 4 to 6. In Fig. 4, the chromatin has begun to divide, but the cytoplasm still envelops it as an irregular covering. Segmentation is more advanced in Fig. 5, where discrete granules scattered throughout the erythrocyte are also visible. Chromatin division is complete in Fig. 6, in which at least 18 discrete and comparatively dense merozoites of varying sizes may be counted. Most of these bodies are ovoid and of average size 1.0 by 0.8 μ. Owing to the associated cytoplasm, a slight variation in density within the bodies of some of the merozoites can be noticed clearly.

At a later stage (Fig. 7), the majority of the merozoites have come out of the host cell, while a few are still inside. Although the size and shape of individual merozoites vary a great deal, the average dimension of the merozoites outside the host cell, is about 0.42 by 0.32 μ, which is smaller than that obtained for the bodies within the fully developed schizont (Fig. 6). On a light print many merozoites show the presence of a distinct vacuole inside. The size of the infected



Figs. 1 and 2. *Plasmodium berghei* in trophozoite stage. Fig. 3. A multiply infected cell. Fig. 4. Early schizont stage. Figs. 5 and 6. Late schizont stage showing progressive segmentation and merozoite formation. Fig. 7. Merozoites scattered around the host cell.

red blood corpuscle is also found to vary with the life-cycle of the parasite. The average size of a noninfected cell is about 5 μ, that of the infected ones is usually 6 to 7 μ. The maximum size is reached in the mature schizont stage (Fig. 6), when the red blood cell measures about 9 to 10 μ.

This brief note describes the results of a preliminary attempt to make malaria parasites visible under the electron microscope while they are still within the erythrocyte. The electron micrographs reproduced here show that the hydrolysis of the fixed cells as described in a foregoing paragraph reduces the masking effect of the cytoplasm to a marked extent. The intracellular parasites are then clearly visible. Such treatment has little effect on the parasites themselves, since mild acid hydrolysis with HCl is a standard cytologic procedure for the study of internal details of cells.

References and Notes

1. C. Wolpers, *Klin. Wochschr.* **21**, 1049 (1942).
2. E. G. Nauck, D. Peters, and R. Wigand, *Z. Naturforsch.* **5b**, 259 (1950).
3. G. B. Chapman and J. Hillier, *J. Bacteriol.* **66**, 362 (1953).
4. A. H. F. Laurell, *Nature* **163**, 282 (1949).
5. R. C. Backus, *J. Appl. Phys.* **24**, 1415 (1953).

6. This research was supported by grants from the Ministry of Education, Government of India. We are indebted to M. N. Saha, director, Institute of Nuclear Physics, and to R. N. Chaudhury, director, School of Tropical Medicine, for their interest in this work.

7. N. N. Das Gupta *et al.*, *Indian J. Phys.* **22**, 497 (1948).

5 April 1954.

Effect of Azide and Cyanide on the Respiration of a Species of *Mycobacterium*

Frederick Bernheim

Department of Physiology and Pharmacology, Duke University Medical School, Durham, North Carolina

Clifton and coworkers (*1–3*) and Winzler (*4*) have shown that sodium azide acts like dinitrophenol in preventing assimilation of added metabolites by certain microorganisms. Instead, the metabolites are oxidized completely to carbon dioxide and water. According to Clifton (*1*) cyanide inhibits the rate of oxidation, although a slight increase in oxygen uptake may occur. The effect of azide and cyanide on autorespiration was not studied.

The question of autorespiration has been somewhat troublesome to workers in bacterial metabolism. Does the cell utilize its stored foodstuffs in the same way as it does added metabolites? And how does the added metabolite affect the autorespiration? An answer to these questions was attempted by studying the effect of azide and cyanide on the respiration of *M. tuberculosis* ATC. No. 8420. Thoroughly washed suspensions of this organism have a relatively high rate of autorespiration, which is increased by both azide and cyanide. It has been shown (*5*) that the addition of certain nitrogen compounds, such as methylamine or ammonium ion, whether assimilated or not, increases the autorespiration. In order to differentiate this effect from that of the drugs, it was shown that the azide and ammonium ion effects were additive (the assimilation of the latter is completely inhibited by azide) and that azide and cyanide allow for the more complete oxidation of added metabolites, such as acetate, caproate, pyruvate, and trehalose, whereas the ammonium ion does not. This increase in the oxidation of added metabolites occurs over and above that caused by the drugs on autorespiration. It therefore appears that these so-called "resting cells" are continuously breaking down, oxidizing, and resynthesizing their stored foodstuff and that these processes are not materially affected by the addition of metabolites.

The organism was grown in 20 ml of Long's synthetic medium for 4 to 6 days. The cells were harvested, and the masses were thoroughly broken up and washed with water by two centrifugations in Hopkins tubes. Seven-tenths milliliter of packed cells was suspended in 7.0 ml of 0.05*M* Na-K-phosphate buffer *p*H 6.0, and 0.5 ml of the suspension was used in each Warburg vessel which had a final fluid volume of 2.0 ml. The effect of azide and cyanide was greater at *p*H 6.0 than at 7.8.

Cyanide concentrations are difficult to keep constant, and it is possible to state only that amounts of KCN varying from 6.0 to 12.0 μg/ml increased the autorespiration on the average 10 percent, and 25 to 37 μg/ml increased it 20 percent after a slight initial depression that lasted 20 to 40 min. Larger amounts depressed for a much longer period of time. Azide was more effective. It increased the autorespiration 25 to 100 percent when 0.1 to 0.5 mg/ml were added, and

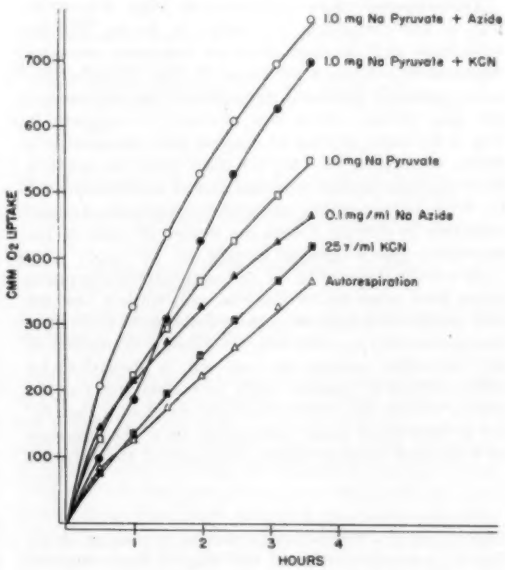


Fig. 1. Effect of cyanide and azide on the autorespiration and on the oxidation of pyruvate.

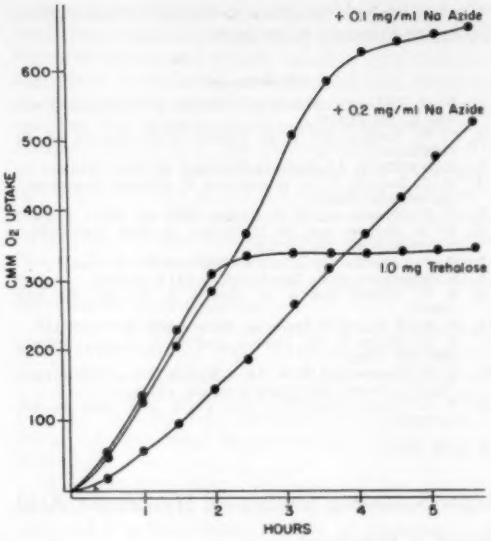


Fig. 2. Effect of two concentrations of azide on the oxidation of trehalose. The respective control respirations have been subtracted.

even the highest concentrations used caused no initial inhibition.

Figure 1 shows the effect of azide and cyanide on the autorespiration and on the oxidation of pyruvate. Pyruvate took up a little less than 2 atoms of oxygen per molecule. The drugs increased this to more than 3. The oxidation of trehalose stopped when 10 to 12 atoms of oxygen per molecule were taken up. This was increased to 18 to 22 by the drugs (Fig. 2). Their effects on the oxidation of the fatty acids such as acetate and caproate were much less striking. The final oxygen uptakes were increased by only a very small amount, and oxidation rates were depressed for several hours. The oxidation of the fatty acids stopped when 50 to 60 percent of the theoretical uptake had been reached. In the absence of added metabolites, both cyanide and azide raised the R.Q. from 0.82 to 0.91, which indicates that the endogenous carbohydrate metabolism is also preferentially affected.

The azide and cyanide effect on autorespiration was not altered after the cells were exposed for 3 min in a sonic vibrator at 9000 cy/sec. The rate of formation of the adaptive enzyme for benzoic acid was decreased 50 percent by this treatment. Exposure for 10 min eliminated the effect of the drugs, although pyruvate was still oxidized at about 25 percent of the normal rate. Neither 1.0 mg/ml of versene nor 0.05 mg/ml of 8-hydroxyquinoline affected the action of the drugs. Ferrous sulfate ($FeSO_4$) in a concentration of 0.5 mg/ml did not inhibit the effect of azide and cyanide on the autorespiration. Cuprie sulfate ($CuSO_4$) inhibited respiration and this was not reversed by the drugs. Cyanate had very little effect and azide was neither reduced to ammonia nor oxidized to nitrite.

Summary. Azide and cyanide affect the autorespiration of these organisms in the same way as they do the oxidation of added metabolites. The effect of these drugs on the autorespiration occurs in the presence of the added metabolites.

References

1. C. E. Clifton, *Enzymologia* **4**, 246 (1937).
2. ——— and W. A. Logan, *J. Bacteriol.* **37**, 523 (1939).
3. M. J. Pickett and C. E. Clifton, *Proc. Exptl. Biol. Med.* **46**, 443 (1941).
4. R. J. Winzler, *J. Cellular Comp. Physiol.* **15**, 343 (1940).
5. F. Bernheim, W. E. DeTurk, and H. Pope, *J. Bacteriol.* **65**, 544 (1953).

21 May 1954.

Site of Conversion of Desoxycorticosterone Acetate to Progestin

E. A. Lazo-Wasem and M. X. Zarrow

Department of Biological Sciences, Purdue University, Lafayette, Indiana

The progestational action of parenterally administered desoxycorticosterone acetate (DCA) has been known for some time. Within recent years, however, it has been demonstrated that DCA has no progestational activity when applied locally to the endometrium of the rabbit (*1*) or mouse (*2*). From a consideration of the chemical configuration, Pfiffner (*3*) has suggested that desoxycorticosterone is probably converted to progesterone in the body and that one step in its metabolic degradation may be by the removal of the primary hydroxyl group. Zarrow, Hisaw, and Bryans (*4*) have presented evidence concerning the conversion of DCA to progesterone *in vivo*, but no information has been advanced regarding the site of this conversion in the organism.

In an attempt to gain information concerning the organs that are involved in such conversion, we have determined the progestin concentrations in the serum of castrated, adrenalectomized, and nephrectomized rats after an intramuscular injection of DCA. All determinations for circulating progestational activity were made by the method of Hooker and Forbes (*5*). Since chemical evidence for the identity of the substance measured by this test is lacking, the term *progestin* will be used for the hormonal activity measured in these experiments. In keeping with previous studies, however, the activity of the progestin has been standardized against progesterone (*6*).

The serum progestin levels of intact male (*7*) or castrated female rats in our colony have been shown to vary between 0 and 1 μg/ml. It may be seen from the data in Table 1, that following the administration of 5 mg of DCA to castrated animals, a maximum level of serum progestin was observed within 4 hr and a return to preinjection levels within 24 hr. Bilateral adrenalectomy or nephrectomy followed by 5 mg of

DCA resulted in maximum serum progestin levels of 2 to 3 μg/ml. These concentrations are not significantly different from the values seen in the castrated control rats and definitely indicate that conversion of DCA to progestin occurred in adrenalectomized or nephrectomized rats. In animals deprived of both the adrenals and the kidneys, however, no detectable circulating progestin was found.

The experiments of Engelhart (*8*), who found that progestational changes could be induced in the uteri of young, unmated rabbits by subcutaneous injections of adrenocortical extracts, were probably the first suggestion concerning the possible elaboration of progestins by the adrenal gland of the mammal. Callow and Parkes (*9*) prepared extracts from the adrenals that caused full progestational changes in the rabbit's uterus, while Beall and Reichstein (*10*) were the first actually to isolate progesterone from the adrenal gland. The detection of circulating, progesterone-like activity in the male has been shown in the intact bird (*11*) and the intact or castrated mammal (*7*). In the case of the rat, increases in serum progestin have been reported within 6 hr following adrenal stimulation (*12*), and the titers of serum progestin present in the intact animal have been shown to disappear following adrenalectomy (*7*). Further evidence for the elaboration of progestin by the adrenal gland may be seen in the results of Lyons *et al.* (*13*) who produced deciduomata in the hypophysectomized, oophorectomized rat treated with ACTH. These facts purport an adrenal source of progestins in the male, but it is not known whether the hormone is secreted specifically by the adrenal gland or whether it results through conversion from other adrenal steroids, such as desoxycorticosterone.

Summary. The conversion of DCA to progestin *in vivo*, which has been shown in the case of the monkey (*4*) and now the rat, indicates one possible mechanism by which progestin may occur in the male. In addition, these studies also show that, at least in the rodent, the adrenals and the kidneys are the sites of this conversion.

Investigations on the conversion of DCA to progestin in other species, as well as studies on the release of progestin by tissue slices incubated with or without DCA, are currently in progress.

Table 1. Mean progestin levels in the serum of the rat following administration of 5 mg desoxycorticosterone acetate (DCA).

Hours after treatment with DCA	Serum progestin (μg/ml) in the rat			
	Castrated	Castrated and adrenalectomized	Castrated and nephrectomized	Castrated, adrenalectomized, and nephrectomized
2	2.00	1.00	1.50	0.00
4	3.33	3.00	2.00	.00
6	2.00	2.00	2.00	.00
12	1.00	1.00	1.00	.00
24	0.33	0.67	0.33	.00

References

1. D. A. McGinty, quoted by Pfiffner, *Advances in Enzymol.* **2**, 325 (1942).
2. C. W. Hooker and T. R. Forbes, *Endocrinology* **45**, 71 (1949).
3. J. J. Pfiffner, *Advances in Enzymol.* **2**, 325 (1942).
4. M. X. Zarrow, F. L. Hisaw, and F. Bryans, *Endocrinology* **46**, 403 (1950).
5. C. W. Hooker and T. R. Forbes, *ibid.* **41**, 158 (1947).
6. M. X. Zarrow and G. M. Neher, *J. Clin. Endocrinol. Metabolism* **13**, 203 (1953).
7. E. A. Lazo-Wasem *et al.*, *Endokrinologie*, in press.
8. E. Engelhart, *Klin. Wochschr.* **9**, 2114 (1930).
9. R. K. Callow and A. S. Parkes, *J. Physiol.* **87**, 28P (1936).
10. D. Beall and T. Reichstein, *Nature* **142**, 479 (1938).
11. R. M. Fraps, C. W. Hooker, and T. R. Forbes, *Science* **109**, 493 (1949).
12. M. X. Zarrow and E. A. Lazo-Wasem, *Proc. XIX Intern. Physiol. Congr.* (Montreal, Canada, 1953).
13. W. R. Lyons *et al.*, *Proc. Soc. Exptl. Biol. Med.* **84**, 356 (1953).

15 April 1954.

Light-Scattering Studies on Hyaluronic Acid

Baruch S. Blumberg*

Department of Medicine, Columbia University, College of Physicians and Surgeons, and *the Edward Daniels Faulkner Arthritis Clinic, Presbyterian Hospital, New York*

Gerald Oster

Institute of Polymer Research, Polytechnic Institute of Brooklyn, Brooklyn, New York

Hyaluronic acid is an important constituent of many body tissues and occurs in synovial fluid, vitreous humor, and umbilical cord. This acidic polysaccharide is also present in some connective tissue and, as such, may take part in the physiological functions of connective tissue—that is, transport, storage, repair, and resistance to infection (*1*). In addition, it appears that there are physicochemical changes of the hyaluronic acid of joint fluids in rheumatoid arthritis (*2*). It is felt that a study of the size and shape of the molecule may contribute to an understanding of the role of this substance in its various physical functions. In the present work we are concerned with the results of light-scattering determinations. Other physicochemical studies are in progress.

Ogston and Stanier (*3*) have studied raw ox-synovial fluid and its ultrafiltrate containing hyaluronic acid. The material in the ultrafiltrates contains approximately 30 percent protein with the hyaluronic acid. By means of flow birefringence and viscosity studies, Ogston and Stainer concluded that the particles are highly hydrated spheres and that under the influence of a shear gradient the particles are deformed.

Light scattering affords a means whereby the size and shape of the particles in solution are determined without subjecting the particles to any external stress and where the theoretical interpretation of the experimental data is explicit.

Hyaluronic acid was prepared in the laboratory of Karl Meyer from umbilical cord by alcohol fractionation after peptic and tryptic digestion (*4*). Chemical analysis of the material gave the following results in percentages: nitrogen, 3.03; hexosamine, 38.0; sulfate, less than 0.4; hexosamine/nitrogen, 0.98; uronic acid (Dische method), 45.5. Our starting solutions were 0.5 percent by weight of hyaluronic acid in a 0.10*M* acetate buffer medium at *p*H 5.0 containing 0.15 molar sodium chloride. The solutions were clarified by centrifugation in a clinical centrifuge at 5000 rev/min for 20 min. The buffer solution used for dilution was clarified by filtering through a fine-grade sintered glass filter and by centrifugation.

Measurements were made in the Aminco Light Scattering apparatus (*5*) using the green line of mercury (λ, 546 mμ) throughout. A micro light-scattering cell was used that required approximately 3 ml of solution (*5*). This cell was surrounded by a larger cylindrical cell containing the solvent to decrease the reflectivity.

The refractive index increment of the solutions $(n-n_0)/c$, where n_0 is the refractive index of the solvent and n is the refractive index of the solution at concentration c (g/ml), needed in the molecular-weight determinations was measured in a Rayleigh interferometer. It was found to equal 0.180 independent of the concentration.

Information from light scattering concerning the size, shape, and molecular weight is gained from two sources, the dissymmetry and the turbidity (*6*). The observed values of the angular scattering given in terms of the dissymmetries (intensity at angle θ divided by the intensity at angle $180°-\theta$, where θ is measured from the transmitted beam) were 5.65, 5.32, 4.77, 3.40, 2.39, and 1.53 for θ equal to 40°, 45°, 50°, 60°, 70°, and 80°, respectively. The dissymmetries were found to be practically independent of concentration from 0.125 to 0.5 percent. The scattering for the solution is greater in the forward directions ($\theta < 90°$) than in the backward directions ($\theta > 90°$). Theory indicates (*6*) that the particles are not rigid rods, since $I_{45°}/I_{135°}$ cannot exceed 2.4, no matter what the length of the rod may be. From theoretical considerations for a random coil (in the high-polymer sense) and a sphere, graphs have been constructed of the dissymmetry for various pairs of supplementary angles, $I_\theta/I_{180°-\theta}$, versus L/λ', where L is the largest dimension of the particle and λ' is the wavelength of the light in the medium; $\lambda' = \lambda/n_0$, where n_0 is the refractive index of the solvent and λ the wavelength of the incident light. The observed values in the present study are incompatible with the theoretical values calculated for a random coil but are all in close agreement with those expected for a sphere where $L/\lambda' = 0.51$. Hence we conclude from the dissymmetry measurements that the particles are spheres of diameter $L = 546 \times 0.51/1.33 = 210$ mμ.

From turbidity measurements, we obtain the molecular weight of the material having a different refractive index from that of the solvent—that is, the "dry" hyaluronic acid. To determine the turbidity, the observed intensity of scattering at 90° was related to the absolute turbidity by the use of Ludox whose absolute turbidity is measured by transmission measurements (*5*). The turbidity at 90° must be multiplied by a factor to account for the lack of symmetry of the scattering envelope (*6, 7*), and this factor is calculated from our observed dissymmetry values to be 2.90. The turbidity divided by the concentration was found to be independent of concentration over the range studied (0.125 to 0.500 percent), although there is evidence for interaction at concentrations higher than these. The solutions that we studied may therefore be regarded as thermodynamically ideal.

For ideal solutions the molecular weight M is given (*6*) by

$$M = \frac{\tau}{Hc}, \text{ where } H = \frac{32\pi^3 n_0^2}{3N\lambda^4}\left(\frac{n-n_0}{c}\right)^2;$$

N is the Avogadro number and τ is the turbidity corrected for the dissymmetry. Since $\lambda = 546$ mμ and for hyaluronic acid $(n-n_0)/c$ is 0.180, then $H = 3.54 \times 10^{-6}$. In our determinations the average value of Hc/τ over the concentration range studied was 1.26×10^{-7} and therefore $M = 8 \times 10^6$.

The dissymmetry measures the outline of a molecule and gives a length corresponding to its greatest dimension. The turbidity gives a value for the molecular weight of the "dry" material present. The molecular weight that we obtained from the corrected turbidity is considerably less than that expected for a sphere of diameter 210 mμ determined from the dissymmetry. It appears, therefore, that the particles are highly swollen spheres of diameter 210 mμ and that the hyaluronic acid contained within the sphere has a molecular weight of 8.0×10^6. Simple calculations show that such spheres contain 0.27 percent by weight of anhydrous hyaluronic acid, and the remainder is presumably water or solvent. Hence the "swelling" is considerable.

It is interesting that the molecular model arrived at by our methods for an essentially protein-free hyalutonate resembles to a great extent the model of Ogston and Stanier (*3*) who used a hyaluronic-protein complex. This finding might indicate that the protein does not contribute to the general shape and physical properties of the molecule.

We wish to thank Karl Meyer for his advice and assistance with this problem and for the preparation of the hyaluronic acid. We further wish to thank Alfred Linker for carrying out the analyses of the material.

References and Notes

* Fellow, Arthritis and Rheumatism Foundation. Supported in part by USPHS grant A-570.

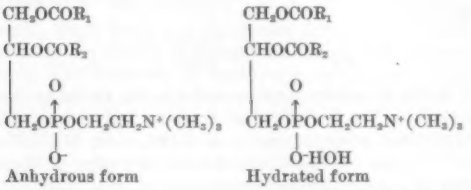
1. C. Ragan, *Ann. Rev. Physiol.* **14**, 51 (1952).
2. ———, *Proc. Soc. Exptl. Biol. Med.* **63**, 572 (1946).
3. A. G. Ogston and J. E. Stanier, *Biochem. J.* **49**, 585 (1951).
4. B. Weissman *et al.*, *J. Biol. Chem.* **205**, 205 (1953).
5. G. Oster, *Anal. Chem.* **25**, 1165 (1953).
6. ———, *Chem. Revs.* **43**, 319 (1948).
7. P. Doty and R. F. Steiner, *J. Chem. Phys.* **18**, 1211 (1950).

9 June 1954.

Communications

Depiction of the Lecithin Molecule

As a modification of the excellent suggestion made by David R. Howton [*Science* **119**, 420 (1954)], it would be well, in view of our present knowledge of acids and bases, to avoid depicting a hydrogen ion (proton) as existing, as such, in the presence of such a strong base as a hydroxyl ion. If the water of hydration is so important, it would be better if it were pictured in the manner indicated here. Note also the coordinate bond between the phosphorus and an oxygen atom.



Anhydrous form | Hydrated form

ARTHUR W. DEVOR

College of Medicine,
Ohio State University, Columbus

2 April 1954.

A Comment on Scientific Writing

In *Science* for 23 April 1954 there were articles on the frequent wordy emptiness and awkward style in scientific writings. Most of the examples quoted and discussed, although poorly written, were nevertheless in correct English. However, the matter is more serious than that: in the mathematical field, at least, outright errors in grammar are not uncommon.

Recently the editors of a journal of a mathematical organization sent me for review a book that furnishes a rather bad example. The volume in question contains a fair proportion of really valuable new work. It was written by a group of distinguished scientists. The native language of the majority was German. The result is a chain of slang and stodgy teutonisms, scattered helter skelter among the commas. To qualify this statement I must add that one of the authors born abroad wrote in clear, precise, and correct English, whereas one of the young native Americans wrote miserably. Young scientists are trained by example, and I fear his case is typical. This aspect of the problem, nothing so refined as mere infelicity of expression, was not mentioned in the articles in *Science,* and for this reason the following paragraphs from my unpublished review may be of interest.

> Now to say no more than this about the style might allow misunderstanding. This particular kettle is only somewhat blacker than the pots in its environment. Not to the tolerance of Americans but to their carelessness must be attributed their willingness to read such maculation of their mother tongue. No German or French editor would dare to publish a comparable haggis of blunders and anglicisms. To the triumph of the jargon of comic strips and advertisements has been added the influx of foreign scientists, especially Germans. The splendid additions brought by these foreign scientists to our scientific life make it easy to see how some young Americans, already ill footed in their mother tongue and mistaking in their masters the certainty of knowledge for correct expression of it, have fallen into a ragged bastardy of language. At the same time there has been a very unfortunate pressure on foreign-born scientists to write in English. That their English is better than our German or French does not make their English correct or clear. That their English is only a little worse than their students' and colleagues', while reflecting little credit to these latter, does not license it. Every editor knows that most manuscripts received contain outright errors which must be corrected silently, while the problem of style is more or less hopeless. I mention all this here because this volume is the worst I have seen: each manuscript, apparently, is printed in its original purity, making the whole a defining example of *die schönste Lengevitch.*
>
> Moreover, since most of this volume is written by persons whose native languages will not tolerate the mangling to which its free (but nevertheless not inexistent) grammar makes English liable, in this case there was a simple remedy. Had the editors encouraged some of the authors to write in German, some of the articles in this volume would have been expressed in a style commensurate with the value of their contents and the result would have come nearer to that clarity without which expository works fail of their purpose.

C. TRUESDELL

Graduate Institute for Applied Mathematics,
Indiana University, Bloomington

10 June 1954.

"Big Business Takes Over Research"

In the issue of 9 July, page 74, J. B. Sumner pays tribute to the governmental and private institutions that "possess the financial backing, the equipment, the highly trained scientists and the technicians to follow up any new lead in science and to carry this lead rapidly to a successful conclusion." The remainder of the letter is a complaint that the university teacher cannot compete successfully with this setup and that this situation is "altogether undesirable."

The university teacher who carries on research as a side line to his teaching and utilizes untrained or partly trained fellows has as his most important function the training of his assistants in the methods of research. He is pointed not at the production of new *facts* so much as at the production of new *researchers.* The university professor must recognize that his first function is education, and no one should underrate that function—certainly not the professor himself. Without competent men, no amount of financial backing or equipment would produce anything.

On the other hand, the object of research itself is to discover new facts and concepts for the benefit of mankind. Big business has in recent years attacked the problems of pure science with the organizational precision that American business knows so well. The result of this business method in research has been a flood of immediately practical therapies that have rudely reversed the mortality figures in many diseases. In the ethical pharmaceutical field the pattern of research, of manufacture, and of distribution have reached an efficiency that has paid off in wide human benefits.

Not the smallest part of this pattern is the widespread distribution of information on new medical products, practically a continuing postgraduate course for all physicians. Here big business has taken the very wise stand that a reputation for honesty and reliability has tangible value, and the professions have been quick to recognize the importance of this flow of service data.

From the point of view of the patient—the average citizen—I hope that your correspondent will reevaluate his estimate of the situation.

PHILIP REICHERT
5220 Empire State Building, New York 1

15 July 1954.

Interaction between Casein and β-Lactoglobulin on Heating

Electrophoretic evidence has been obtained which indicates that casein and β-lactoglobulin, the major protein constituents of milk, combine under the influence of heat, forming a stable complex (*1*). When a 1 percent protein mixture composed of 0.75 percent casein and 0.25 percent β-lactoglobulin in 0.1 ionic strength phosphate buffer of *p*H 6.86 was heated at 85°C for 30 min, and electrophoresis was carried out in the same buffer, the β-lactoglobulin migrated with the α-casein. Three well-separated electroproretic peaks (α- and β-casein and β-lactoglobulin) were obtained for the unheated mixture at this *p*H. A solution of 0.25 percent β-lactoglobulin in the *p*H 6.86 buffer, heated in the same manner, yielded two electrophoretic peaks. The more rapidly migrating peak had a mobility slightly lower than that of the α-casein peak in the unheated mixture but about the same as that of the proposed complex of β-lactoglobulin and α-casein in the heated mixture.

If β-lactoglobulin and α-casein had not actually formed a stable complex, it should be possible to resolve the two components by performing the electrophoresis at a different *p*H. In an attempt to so resolve the denatured β-lactoglobulin and α-casein components, electrophoresis of mixtures prepared and heated in the same manner was carried out in *p*H 2.45 glycine-HCl buffer of ionic strength 0.1. No component was present in the electrophoretic pattern of the heated mixture obtained at *p*H 2.45 that had the mobility of heat-denatured β-lactoglobulin. (Heat-denatured β-lactoglobulin showed a single peak at this *p*H.) The proposed complex, identified on the basis of the area of its electrophoretic peak, migrated with a mobility appreciably lower than that of heated or unheated β-lactoglobulin or unheated α-casein. The area of the complex peak at *p*H 2.45 was not as great as the area of this peak at *p*H 6.86, but it was quite evident from the dissimilarities between the ascending and descending patterns that interactions of an ionic nature occurred at *p*H 2.45 in the heated mixture. The ionic interactions introduced considerable uncertainty into the identification of the components other than the large peak that was assumed to be the complex between α-casein and β-lactoglobulin.

The evidence, although not conclusive, is supported by similar observations made by Jennings (*2*) and Krejci (*3*) that casein formed a complex with a horse serum immune globulin under the influence of heat.

Heat-induced interactions between proteins may be of considerable significance with respect to protein stability problems in food processing.

Work is in progress to confirm the existence of α-casein-β-lactoglobulin complexes in heated synthetic mixtures and in heated and dried milk.

WESLEY A. MCGUGAN
VIRGINIA F. ZEHREN
VINCENT L. ZEHREN
ARTHUR M. SWANSON
Department of Dairy and Food Industries, University of Wisconsin, Madison

References and Notes

1. This paper reports research undertaken in cooperation with the Quartermaster Food and Container Institute for the Armed Forces and has been assigned number 490 in the series of papers approved for publication. The views and conclusions are those of the authors; they are not to be construed as necessarily reflecting the views or endorsement of the Department of Defense.
2. R. K. Jennings and L. D. Smith, *J. Immunol.* **45**, 105 (1942).
3. L. E. Krejci, R. K. Jennings, and L. D. Smith, *J. Immunol.* **45**, 111 (1942).

6 July 1954.

Antibiotic-like Substance and Cellulose Digestion Stimulator Found in Fermented Feeds and in Rumen Fluid*

Factors that stimulate *in vitro* cellulose digestion by rumen microorganisms have been found in fresh rumen fluid and its extracts (*1–3*). Cow manure and common feedstuffs have also been shown to contain similar factors (*4*). However, previous workers have not reported an antibiotic-like factor in these materials.

A factor, or factors, that stimulates the growth and cellulolytic activity of rumen microorganisms and inhibits the growth of microorganisms previously isolated as undesirable contaminants from the digestive tracts of ruminants has been obtained in crude form. Active extracts were prepared from four bovine ingesta, one ovine ingesta and two fermented feeds.

The extracts were free of microorganisms and stable to autoclaving at a *p*H between 7 and 10.

Inhibition of *Micrococcus flavus* was shown by the standard plate technique for antibiotics. The extracts were further checked for bactericidal or bacteriostatic action against *Pseudomonas aeruginosa* and *Aerobacter aerogenes* by turbidity measurements.

Cellulose digestion, *in vitro*, was enhanced and the lag phase of washed rumen microorganisms was shortened when 0.1 ml of the extracts was added to 11 ml of the culture medium. Further studies are under way to determine the nature of the factor responsible for the inhibitory effect on contaminating microorganisms of the rumen.

G. B. GARNER
M. E. MUHRER
W. C. ELLIS
W. H. PFANDER

Departments of Agricultural Chemistry and Animal Husbandry, College of Agriculture, University of Missouri, Columbia

References and Notes

* Journal Series Paper No. 1459 approved by the director of the Missouri Agricultural Experiment Station.

1. O. G. Bentley *et al.*, *Federation Proc.* **13**, 182 (1954).
2. R. N. Doetsch, *J. Animal Sci.* **2**, 536 (1952).
3. R. E. Hungate, *Bacteriol. Revs.* **14**, 1 (1950).
4. E. W. Ruf *et al.*, *J. Animal Sci.* **12**, 731 (1953).

13 May 1954.

Tarahumara Indian Piscicide: *Gilia macombii* Torrey

During a recent expedition among the Tarahumara Indians (*1*) in the Sierra Madre Occidentalis of northwestern Mexico for medical and ethnologic studies, I inquired of the Indians about the present-day use of fish poisons. Only a small number of these seminomadic, part-time cave-dwellers—those Indian families living near the Rio Conchos and other large rivers of the Sierra—still used piscicides. Among those still employed, I found *Gilia macombii* Torrey, a plant not previously reported to have been used as a fish poison or known to be pharmacologically active in fish or mammals.

The fish poisons previously reported from the Tarahumara Sierra by Lumholtz (*2*), Bennett and Zingg (*3*), and Clavigero (*4*) are summarized in Table 1.

Table 1. Fish poisons previously recorded.

Plant	Part used	Reference
Agave sp.	Leaves	(*2*)
Polygonum sp.		(*2*)
"Palo de la flecha"	Bark	(*2*)
Calcalia decomposita A. Gray	Entire plant	(*3*)
Casimiroa edulis Llav. and Lex	Entire plant	(*3*)
Casimiroa sapota Oerst	Entire plant	(*3*)
Tephrosia talpa Wats (Synonym: *Cracca talpa* Wats)	Root	(*3*)
Sebastiania bilocularis S. Wats	Sap	(*4*)

I was told by Indian informants in the Sisoguichi and Norogachi areas of several fish poisons still in use. We were able to collect only the one called by the Tarahumara *nawé* and another called *matéshuwa*. In the area between Sisoguichi and Norogachi *matéshuwa* was in bloom in September 1953 in the lower land along streams. *Nawé* was found in the Wichaiochi area. Only the root was used as a piscicide. It is a fish poison of the genus *Tephrosia* (*5*).

Different informants in Sisoguichi, Wichaiochi, and Norogachi considered the purple-flowered plant they called *matéshuwa* to be the most potent fish poison in the region. The entire plant (stems, leaves, and flowers) except the root was used by crushing the freshly gathered plant between rocks in a dammed, slowly flowing part of the stream. The Indians claim that a few armloads of the plant are sufficient to stun the fish and to cause them to rise to the surface for several hundred yards downstream. The poisoned fish may be eaten without danger.

Lyman B. Smith, curator of the Division of Phanerograms of the Smithsonian Institution, has identified pressed specimens of *matéshuwa* as *Gilia macombii* Torrey. Species of *Gilia* have not previously been reported as piscicides of the Tarahumara or of any other ethnic group (*5*), nor have toxic substances been associated with this genus in the past.

Preliminary experiments, carried out with Charles L. Wisseman of the Army Medical Center, using goldfish (sp.) weighing 3 to 5 g, indicate that a filtered, cold aqueous extract made from powdered dried plant in a concentration of 1.0 mg/ml is sufficient to stun the fish in 10 min and to kill them in less than 50 min. The fish rise frequently to the surface to swallow air, lose their equilibrium and lie on their side, and become inactive except for quick jerking movements before dying. An extract made from only 0.2 mg/ml of the dried powdered plant has killed the goldfish in 2 to 2.5 hr. Plants dried at room temperature for 3 mo were used.

D. CARLETON GAJDUSEK

Department of Medicine, Medical School, University of Maryland, College Park
Present address: Institut Pasteur de l'Iran, Teheran

References

1. D. C. Gajdusek, *Geograph. Rev.* **43**, 15 (1953).
2. K. Lumholtz, *Unknown Mexico* (Scribners, New York, 1902), vol. 1.
3. W. C. Bennett and R. M. Zingg, *The Tarahumare* (Univ. of Chicago Press, Chicago, 1935).
4. F. J. Clavigero, *The History of (Lower) California.* (Stanford Univ. Press, Stanford, Calif., 1937).
5. R. F. Heizer, *U.S. Bur. Am. Ethnol. Bull. 151*, Anthrop. Paper No. 38 (1910), p. 225.

1 June 1954.

Kodak reports to laboratories on:

where to look for organic chemicals... high speed film for high speed movies... two silver salts in the infrared

List No. 39

This and every year, myriads of companies spawn numberless catalogs, each a jewel in the crown of some sales manager, each a brick in the edifices of the printing industry and the filing cabinet industry. Here *we* come with yet another and with the presumption to proclaim its advent an event. In support we

cite the reception accorded the 38 predecessors of the vivid turquoise *Eastman Organic Chemicals List No. 39*, which has just been mailed out to those who have told us in past years that they would want it.

We speculate sometimes on why the Eastman Organic catalog is in such high demand by working practitioners of science. Among the more tenable hypotheses, may be listed:

1. It's handy to have around a book weighing less than a pound that gives the *Chem Abstracts* names, laboratory-quantity prices, structural formulas, molecular weights, and melting or boiling ranges (observed, not just quoted) of a representative group of some 3500 organic compounds.

2. It provides a means of distinguishing between the hundreds of thousands of organic compounds known to exist and those actually obtainable by mail or phone order from a single, eminently responsible source (148 items have been added to the latter class in the new edition).

3. It provides routine but useful compilations on matters like pH indicator ranges; transparency regions of spectrophotometric solvents; reagents for a great host of analytical tests; liquids for refractive index determination; listings of sugars, vitamins, amino acids, alkaloids.

Now is the time for anyone who needs to know about the availability of organic compounds for the laboratory and who has not yet received List No. 39 *to demand it of Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company). Though the catalog is free for the asking and the rate of its distribution has been accelerating at a mad pace for the past 35 years, we are always running into deserving people who want it but don't have it. Can't figure that.*

High speed boon

In Paris this month at an international symposium on high speed photography, we are announcing 16mm *Cine-Kodak Tri-X Negative Film*. We are making a scholarly and dispassionate exposition of the factors governing choice of emulsion characteristics for high speed motion pictures and in due course of the argument we bring out that the new film has at least twice the speed of the valiant old "Super-XX," with about the same graininess. The happy implication to the man with a *Kodak High Speed Camera* is that he can close down his lens to get more depth of field, or he needn't pour so much light on his subject.

Cine-Kodak Tri-X Negative Film is now obtainable from your Kodak dealer, not only spooled for the rigors of high speed cameras (and so labeled) but also for more orthodox 16mm movie cameras used in newsreel, industrial, and sports photography. ASA Exposure Indices for conventional work are 250 for daylight and 200 for tungsten. Actually, this film outstrips the vision of some exposure meter designers by often making possible a quite adequate picture under illumination so low that the photographer can't get any response out of his meter.

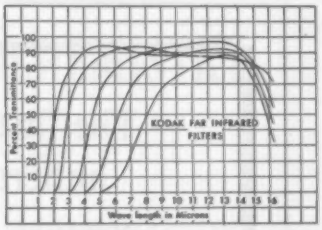
For a technical data sheet on Tri-X *motion picture film, write Eastman Kodak Company, 343 State Street, Rochester 4, N. Y. We do not process this film.*

Far infrared filters

The rock on which our house is founded is of gloriously photosensitive silver bromide. We now uncover to public gaze a small outcropping of two other silver salts of quite different function—silver chloride and silver sulfide.

Silver chloride in monocrystalline sheet is about as pliable as a fresh stick of chewing gum just out of the wrapper. When optically polished, AgCl becomes one of the most transparent of solids all the way out to 17μ in the infrared. We know a way to film over such a polished silver chloride plate with a smoke of silver sulfide. The result is a *Kodak Far Infrared Filter*.

Spectral transmittance depends on how the Ag_2S is applied. It's an empirical matter, involving a combination of spectrally selective scatter and absorbance, but we have nice control over it. We can deliver a filter with any specified specular transmittance, as delineated by this family of curves:



You designate any of nine equally spaced short-wavelength cut-offs from 1μ to 5μ, and we undertake to give it to you within a tolerance of $\pm$ .2μ.

For a full price schedule on Kodak Far Infrared Filters, *write Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y. The lowest price per filter is $28.50 in lots of 5 for the 1" size with a cut-off between 1μ and 3μ. The highest standard price is $131 for a 5" filter with a cut-off between 3.5μ and 5μ. We quote three months' delivery but don't usually take that long. Keep watching for further developments of our excursion into that end of the rainbow where Sir William Herschel had the wit to stick his thermometer in 1800.*

Prices quoted are subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are ... *serving laboratories everywhere*

Kodak

there must be a reason

Here are eight distinct reasons why **Haemo-Sol** is the preferred cleaner for laboratory glassware.

- Completely Soluble
- Leaves No Residue
- Fully Haemo-Digestive
- Lower Surface Tension
- Scientifically Formulated
- Controlled pH
- Multiple Laboratory Uses
- Greater Economy

for literature and samples write today to:

MEINECKE & COMPANY, INC.

225 Varick St. · New York 14, N. Y.

CANCER the subject of

outstanding A. A. A. S. Symposium Volumes:

MAMMARY TUMORS IN MICE, 1945:

10 contributors, viii + 223 pages, 7½ x 10½, clothbound, double column, illustrated, $3.50. Cash order price to A.A.A.S. members, $3.00. Coordinated knowledge of cancer of the breast in mice. It cannot fail to stimulate interest and further research efforts in one of our most fascinating and important biological problems. Prepared by members of the staff of the National Cancer Institute.

APPROACHES TO TUMOR CHEMOTHERAPY, 1947:

93 contributors, x + 442 pages, 7½ x 10½, clothbound, double column, illustrated, $7.75. Cash order price to A.A.A.S. members, $6.50. A progress report, addressed largely to future workers. An important and trustworthy reference book. Planned under the auspices of National Cancer Institute, Memorial Hospital of New York, Sloan-Kettering Institute for Cancer Research, Lankenau Institute of Philadelphia, and others.

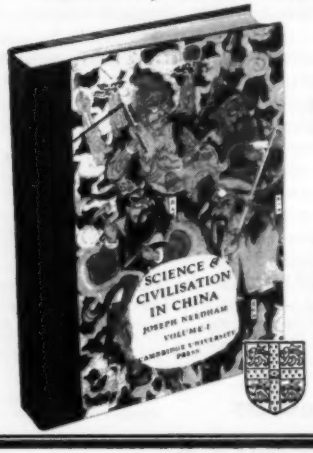
TO: AAAS PUBLICATIONS
1515 Mass. Ave., N.W., Washington 5, D. C.

Enclosed is $ ..... Please accept my order for

☐ MAMMARY TUMORS in MICE

☐ APPROACHES to TUMOR CHEMOTHERAPY

The first comprehensive survey of China's hitherto unrecognized contributions to science, technology, and scientific thought



SCIENCE & CIVILISATION IN CHINA

By JOSEPH NEEDHAM, F.R.S.

Volume I is an introduction to China and her people from prehistoric times to the 17th century. Dr Needham examines the structure of the Chinese language, reviews the geography and the long history of the country, and discusses the scientific contacts between East and West. The first volume is preparatory to a more detailed study in the six volumes that will follow. Volume I is $10.00 at all bookstores.

CAMBRIDGE UNIVERSITY PRESS

Ready for FALL *Classes!*

Kleiner— HUMAN BIOCHEMISTRY

New Fourth (1954) Edition

By ISRAEL S. KLEINER, Ph.D., Professor of Biochemistry and Director of the Department of Biochemistry, New York Medical College, Flower and Fifth Avenue Hospitals. Fourth Edition. 730 pages, 93 text illustrations, five color plates. Price $7.50.

In this new 1954 edition the author has attempted to keep sight of the vast new horizons in biochemistry. The first object has of course been to eliminate any concepts which have changed or are of doubtful nature. More difficult has been the task of selecting from the almost limitless researches those advances which seem to be authenticated and at the same time of significant value to the student. The original purpose of the book—to create a useful, understandable, and compact volume—has been kept in mind constantly. Every chapter has been examined critically. Large areas have been completely rewritten, notably those dealing with blood coagulations, enzymes and coenzymes, physiological oxidations, cholesterol metabolism, urea formation, transmethylation, and the mechanism of insulin action. Among the new topics are the dextrans, triiodothyromine, glucagon, secretonin, the carbonic anhydrase inhibitors, blood iodine, lipoic acid, and the structure of insulin and of oxytocin. A section is devoted to the nomenclature of the steroids.

Kleiner-Dotti— LABORATORY INSTRUCTIONS in BIOCHEMISTRY

By ISRAEL S. KLEINER, Ph.D., Professor of Biochemistry and Director of the Department, New York Medical College, Flower and Fifth Avenue Hospitals; and LOUIS B. DOTTI, Ph.D., Chemist, St. Luke's Hospital. Fourth Edition. 290 pages. Price $3.50.

Designed for use with "Human Biochemistry," this manual is adaptable to any text on biochemistry. The most noteworthy changes in this edition are the addition of experiments with ion exchange resins and paper chromatography, the phosphatase test for pasteurization, and the Somogyi-Nelson blood-sugar procedure.

Contents: Physical Chemistry. Carbohydrates. Lipids. Proteins. Tissues. Milk. Digestion. Qualitative Examination of Blood. Qualitative Urine Analysis. Quantitative Analysis of Blood and Cerebrospinal Fluid. Quantitative Urine Analysis. Metabolism Experiment. Toxicology. Blood Gas Analysis. Nutrition Experiments. Appendix.

THE C. V. MOSBY COMPANY,
3207 Washington Blvd.,
St. Louis 3, Missouri

Date .....

Gentlemen: Send me the book(s) checked with (X). ☐ Attached is my check. ☐ Charge my account.

☐ Kleiner—Human Biochemistry $7.50
☐ Kleiner-Dotti—Laboratory Instructions in Biochemistry ... 3.50

Name ..... Street .....

City ..... Zone ..... State .....

SC-9-10-54

TWO NEW TEXTS FOR YOUR FALL CLASSES

INTRODUCTION TO ASTRONOMY

by Cecilia Payne-Gaposchkin, Ph.D., Phillips Astronomer, Harvard University.

OUTSTANDING FEATURES:

- Of particular importance is the embodiment of the recent drastic changes in our knowledge of the sizes of galaxies and of the observable universe as presented at the Rome IAU meetings, making INTRODUCTION TO ASTRONOMY the only text to include this information.
- Outstanding among the numerous and excellent illustrations are the Lowell Observatory photographs of the planets. Without a doubt this is the finest collection of such pictures anywhere available. Also included for the first time are examples of the latest and finest halftone illustrations from the great new instruments, including the 200-inch.

480 pages • *6" x 9"*

ELEMENTARY METEOROLOGY

by George F. Taylor, Ph.D., Colonel, U. S. Air Force Reserve. Formerly Chief Meteorologist, American Airlines. Now an advisor to AEC.

A completely up-to-date treatment of basic meteorology at the elementary level. Of special interest is the first chapter, "The Setting," which is an extremely interesting description of the present theories of the origin of the earth. Then follows a systematic coverage of the components of the weather, and how they are measured. An unusually complete treatment of air masses is found in Chap. 9. In addition to the complete coverage of meteorology, Chap. 15 presents an introduction to the field of climatology and presents some very recent work on synoptic climatology. World wide and local climatic changes are discussed and possible reasons are evaluated.

342 pages • *6" x 9"*

PRENTICE-HALL, INC.
70 Fifth Avenue, New York 11, N. Y.

Radio-Active STEROIDS

IMMEDIATELY AVAILABLE

ESTRONE 16-C^{14}
Activity per mg. 2.7 microcuries
Price per mg. $50.00

ESTRADIOL 16-C^{14}
Activity per mg. 2.7 microcuries
Price per mg. $65.00

PROGESTERONE 21-C^{14}
Activity per mg. 2.25 microcuries
Price per mg. $40.00

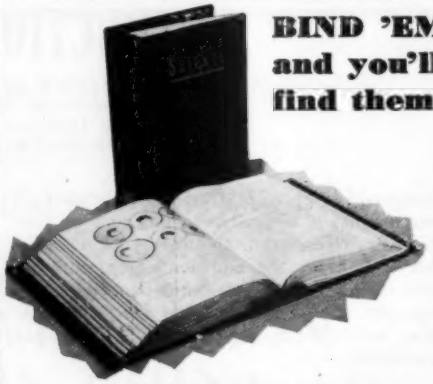
DESOXYCORTICOSTERONE ACETATE 21-C^{14}
Activity per mg. 2.25 microcuries
Price per mg. $40.00

Statement of your government department dealing with atomic energy together with "Atomic Energy of Canada Limited Form No. 247" should be filed with each order.

For these forms and other information, write to:

Charles E. Frosst & Co. . . .
PHARMACEUTICAL and CHEMICAL MANUFACTURERS

P.O. BOX 247
MONTREAL, CANADA



BIND 'EM... and you'll find them!

Keep your copies of SCIENCE always available for quick, easy reference in this attractive, practical binder. Simply snap the magazine in or out in a few seconds—no punching or mutilating. It opens FLAT—for easy reference and readability. Sturdily constructed—holds 26 issues.

This beautiful maroon buckram binder stamped in gold leaf will make a fine addition to your library. Only $2.75 postpaid (personal check or Money Order please). Name, 75¢ extra—year of issue, 50¢ extra. ORDER YOURS NOW!

SCIENCE • 1515 Mass. Ave., N.W., Washington 5, D. C.

Leitz brings you the

LABOLUX

a new medical microscope
with truly functional design

Coarse and fine adjustment on a common axis with single control knob • Binocular tube in bayonet mount can be set in forward or reversed position • Interchangeable inclined or straight monocular tubes available • Tube remains stationary, stage moves on ball bearings in focusing • Micro-Dia lamp set into foot of microscope is interchangeable with mirror. E. LEITZ, Inc., distributor of world-famous products of Ernst Leitz, Wetzlar, Germany.

E. LEITZ, Inc., Dept. SC
468 Fourth Avenue, New York 16, N.Y.
Please send me your brochure on the Labolux.
Name _____
Street _____
City _____ State _____

Leitz
microscopes
binoculars
Leica cameras
lenses

GET YOUR ADVANCE COPY

of the General Program-Directory of the Berkeley Meeting of the AAAS

By first class mail – early in December

The General Program-Directory of the 121st Meeting of the AAAS on the campus of the University of California, Berkeley, Dec. 26–31, 1954, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The three-part General Symposium: "Science and Society."
2. Programs of the 18 AAAS sections (symposia and contributed papers).
3. Programs of the more than 70 participating societies.
4. The Special Sessions: AAAS, Academy Conference, Third Berkeley Symposium on Mathematical Statistics and Probability, Conference on Scientific Editorial Problems, National Geographic Society, Pacific Science Board, Phi Beta Kappa, Phi Kappa Phi, RESA, Sigma Xi.
5. Details of the Gymnasium for Men—center of the Meeting—and campus.
6. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
7. Exhibitors in the 1954 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1954.
2. Complete roll of AAAS presidents and their fields.
3. The 260 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS—through 1958.

Advance Registration

Advance registration has these decided advantages: 1) You avoid delay at the Registration Center upon arrival; 2) You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3) Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

——— THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM-DIRECTORY ———

1a. ☐ Enclosed is $2.50 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.

1b. ☐ Enclosed is $1.50 for only the Program-Directory. (It is understood that, if I should attend the Meeting later, the Badge—which is necessary for all privileges of the Meeting—will be secured for $1.00 more.)
(Check one)

2. FULL NAME (Dr., Miss, etc.) .....
(Please print or typewrite) (Last) (First) (Initial)

3. ACADEMIC, PROFESSIONAL, OR BUSINESS CONNECTION .....

4. OFFICE OR HOME ADDRESS .....
(For receipt of Program-Directory)

5. YOUR FIELD OF INTEREST .....

6. CONVENTION ADDRESS .....
(May be added later, after arrival)

Please mail this Coupon and your check or money order for $2.50 or $1.50 to the
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 Massachusetts Avenue, N.W., Washington 5, D. C.

TRAVEL ARRANGEMENTS FOR THE AAAS BERKELEY MEETING

December 26-31, 1954

In time or in cost, a trip from an eastern city to California is not much more than a **round trip** to a midwestern city. Californians who for years have been attending meetings in the East have told their colleagues that the continental distance is the **same** each way, and that it should be the turn of the Easterners to visit the Pacific Coast.

The Association is planning ways it may assist those who will attend the 121st AAAS Meeting on the campus of the University of California at Berkeley, this December. The possibilities include:

1. Low cost AAAS limousines from Oakland and San Francisco airports and railroad terminals direct to the dormitory or hotel of each delegate.
2. Arrangements for traveling together in AAAS cars on fast trains leaving Chicago, Washington, D. C., and New York.
3. Arrangements for chartering first class DC6, 6B, or 7 planes of scheduled airlines—at prices comparable with air coach travel.

Note: In the following table of **round-trip** fares all figures include the new lowered 10% federal tax.

ROUND TRIPS TO OAKLAND OR SAN FRANCISCO FROM

	Chicago	Washington, D. C.	New York
By Bus	Time: 2½ days $82.50	Time: 4 days $104.94	Time: 4 days $112.31
By Rail	Time: 2½ days — leaving evening, Dec. 24 and morning, Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31
Reclining seat coach	$ 99.17	$147.62	$156.64
First class	$139.10	$204.33	$222.67
Lower berth	46.20	60.06	63.58
Total	$185.30	$264.39	$286.25
By Air	Time: 7–8 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m. Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31
Air coach (no meals)	$167.20	$215.60	$217.80
Chartered 1st class (meals included)	c. $178.00	c. $235.00	c. $235.00
First class (meals included)	$239.91	$312.18	$332.09

PLEASE READ ABOVE TABLE, FILL OUT THIS COUPON, AND SEND IT TO

AAAS TRAVEL — Dr. R. L. Taylor
1515 Massachusetts Avenue, N.W.
Washington 5, D. C.

Name .....

Address .....

I shall probably attend the AAAS Meeting in Berkeley. Without obligation I am interested in possible group travel arrangements to San Francisco from:

1. ☐ Chicago ☐ Washington, D. C. ☐ New York ☐ Other city: .....
2. My preferred manner of transport is:
   ☐ Rail — coach ☐ Air — coach ☐ Bus
   ☐ Rail — 1st class ☐ Air — chartered, 1st class ☐ Other
   ☐ Air — 1st class
3. I would
   ☐ return east immediately after the meeting
   ☐ like to make a side trip to .....
   ☐ remain indefinitely on the Pacific Coast

Outstanding

McGRAW-HILL BOOKS

HUMAN PHYSIOLOGY. New second edition

By BERNARDO A. HOUSSAY, JUAN T. LEWIS, OSCAR ORIAS, EDUARDO BRAUN-MENENDEZ, ENRIQUE HUG, VIRGILIO G. FOGLIA, and LUIS F. LELOIR, all Medical Doctors. Translated by JUAN T. LEWIS, M.D. and OLIVE THOMAS LEWIS. In press

This is the new second edition of an internationally acclaimed text presenting all the aspects of human physiology in both their chemical and physical relationships. Nobel Prize winner Dr. Houssay, and his associates, have made extensive modifications and additions to their original work which incorporate the latest data in the field. The chapters on electrical activity of the heart, digestion, carbohydrate metabolism, the physiology of the senses, and the nervous system have been entirely recast. The discussion of the nervous system includes recent advances in the mechanism of conduction of the nerve impulse and synaptic transmission. New knowledge has also been added to the chapters on cellular respiration, vitamins, blood-clotting, the kidney, and sexual physiology and reproduction.

ANALYTICAL CYTOLOGY

Edited by ROBERT C. MELLORS, Sloan-Kettering Institute for Cancer Research. In press

A group of authors, each an authority in his field, have brought together some of the newer physical and chemical methods for studying cellular form and function. Newer developments and applications of the microscope are discussed in terms of theory and application to biological problems. In addition to the use of light in cytological analysis, other methods using forms or carriers of radiant energy, such as electron microscopy and historadiography, are included. The more important staining methods are also reviewed. Extensively illustrated with diagrams and halftones.

AN OUTLINE OF DEVELOPMENTAL PHYSIOLOGY

By CHR. P. RAVEN, University of Utrecht, The Netherlands. 234 pages, $5.50

A distinguished contribution to the field of embryology. The book deals with causal factors of development i.e., the causes of all changes, leading from the fertilized egg to the adult organism. The subject matter is presented from the viewpoint that development may be regarded as a transformation of intensive (non-spatial) multiplicity into extensive (spatial) multiplicity. The treatment is theoretical but simple, and the book is intended for undergraduate and postgraduate students.

Send for copies on approval

McGRAW-HILL BOOK COMPANY, Inc.

330 West 42nd Street • New York 36, N. Y.

Meetings & Conferences

October

8–9. Acad. of Psychosomatic Medicine, 1st annual, New York City. (E. A. Brown, 75 Bay State Rd., Boston 15.)

11–12. Ferrimagnetism Conf., Silver Spring, Md. (L. R. Maxwell, U.S. Naval Ordnance Laboratory, Silver Spring.)

11–13. American Oil Chemists' Soc., 28th annual fall, Minneapolis. (L. R. Hawkins, AOCS, 35 E. Wacker Dr., Chicago 1.)

11–14. Cong. of International Anesthesia Research Soc., Los Angeles. (T. H. Sheldon, 102–110 Second Ave., Rochester, Minn.)

11–15. American Public Health Assoc., Buffalo, N.Y. (R. M. Atwater, 1790 Broadway, New York 19.)

11–16. Symposium on Light Microscopy and Symposium on Electron Microscopy, Highland Park, Ill. (W. C. McCrone, Illinois Inst. of Technology, Chicago 16.)

13–17. Audio Engineering Soc., annual, New York City. (O. J. LeBel, AES, P.O. Box 12, Old Chelsea Station, New York 11.)

14–15. Bicentennial Conf. of the Columbia University College of Pharmacy, New York City. (G. W. Merck, Merck & Co., Rahway, N.J.)

14–16. Electron Microscope Soc. of America, Highland Park, Ill. (J. R. Cooper, ESMA, General Electric Co., Cleveland 12, Ohio.)

14–16. Gaseous Electronics Conf., 7th annual, New York, N.Y. (L. H. Fisher, New York University, New York 53.)

14–16. Indiana Acad. of Science, Lafayette, Ind. (W. A. Daily, Eli Lilly & Co., 740 S. Alabama St., Indianapolis 6.)

14–16. Optical Soc. of America, annual, Los Angeles. (A. C. Hardy, Massachusetts Institute of Technology, Cambridge 39, Mass.)

15–17. International Colloquium on Dermatology and Syphilography, 5th, Marseilles, France. (J. Bonnet, Hotel-Dieu, Place Daviel, Marseilles.)

18–20. Conf. on Electrical Insulation, Pocono Manor, Pa. (A. McLean, 2101 Constitution Ave., Washington 25, D.C.)

18–20. IRE–RETMA, fall, Syracuse, N.Y. (E. K. Gannett, 1 E. 79 St., New York 21.)

18–21. Mental Hospital Inst., 6th, Minneapolis, Minn. (W. Malamud, 80 E. Concord St., Boston 18.)

18–22. American Soc. of Civil Engineers, New York City. (W. M. Carey, 33 W. 39 St., New York 18.)

18–22. Soc. of Motion Picture and Television Engineers, semi-annual, Los Angeles. (SMPTE, 342 Madison Ave., New York 16.)

19. American Soc. of Safety Engineers, Chicago. (J. B. Johnson, 425 N. Michigan Ave., Chicago 11.)

21–22. National Noise Abatement Symposium, 5th annual, Chicago. (S. M. Potter, Illinois Inst. of Technology, Chicago 16.)

21–23. International Assoc. of Milk and Food Sanitarians, Atlantic City, N.J. (H. L. Thommasson, IAMFS, Box 437, Shelbyville, Ind.)

21–23. International Symposium on the Dynamics of Virus Infections, Detroit. (Henry Ford Hospital, 2799 W. Grand Blvd., Detroit 2.)

21–24. American Dietetic Assoc., annual Philadelphia. (E. A. Atkinson, 620 N. Michigan Ave., Chicago 11.)

(See issue of 20 August for more comprehensive listings.)

Now Complete:

Chemical Pathways of Metabolism

Edited by DAVID M. GREENBERG, *University of California*

HERE is a complete, authoritative and up-to-date presentation of the pathways and mechanisms of the chemical transformations and reactions of the foodstuffs and cellular constituents in the living organism. Each chapter is written by an authority on the subject who is actively engaged in research in that field.

Volume I, June 1954, xii, 460 pages, illustrated, $11.00

Free Energy and Metabolism
By ARTHUR B. PARDEE
Enzymes in Metabolic Sequences
By DAVID E. GREEN
Glycolysis
By P. K. STUMPF
The Tricarboxylic Acid Cycle
By H. A. KREBS
Other Pathways of Carbohydrate Metabolism
By SEYMOUR S. COHEN
Biosynthesis of Complex Saccharides
By W. Z. HASSID
Fat Metabolism and Acetoacetate Formation
By I. L. CHAIKOFF and G. W. BROWN, JR.
Sterol and Steroid Metabolism
By DAVID K. FUKUSHIMA and ROBERT S. ROSENFELD
Author Index—Subject Index.

Volume II, August 1954, x, 383 pages, illustrated, $9.50

Nitrogen Metabolism of Amino Acids
By P. P. COHEN
Carbon Catabolism of Amino Acids
By D. M. GREENBERG
Synthetic Processes Involving Amino Acids
By D. M. GREENBERG
Metabolism of Sulfur-Containing Compounds
By D. M. GREENBERG
Enzymatic Syntheses of Peptide Bonds
By H. BORSOOK
Purines and Pyrimidines
By MARTIN P. SCHULMAN
Nucleotides and Nucleosides
By LEON A. HEPPEL
Metabolism of Heme and Chlorophyll
By S. GRANICK
Author Index—Subject Index.

Academic Press Inc., Publishers

125 East 23 Street, New York 10, New York

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries — at a very low cost

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis —provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS WANTED

Biochemist; M.S. (Chemsitry); Ph.D. (Major, Biochemistry, Minor, Organic Chemistry) four years, assistant professor of biochemistry, one of leading universities; five years, chief of biochemistry, research department of sixty scientists. Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

Microbiologist–Immunologist: D.V.M., Ph.D. 34. Presently Assoc. Prof. state university. Desires research or research and teaching position. Ten years infectious disease research, teaching. East preferred. Box 237, SCIENCE. 9/10

Ph.D. Sigma Xi. University and Cancer research experience. Neuroanatomy, Histology, Cytopathology, Tissue Culture. Seeks position in New York City, part or full time. Box 239, SCIENCE. X

Research Glassblower—West coast preferred. Box 241, SCIENCE. X

POSITIONS OPEN

Comparative physiologist to teach and conduct research. $4500–$6500. Department of Physiology, Florida State Univ., Tallahassee. 9/17

(a) **Organic chemist,** experienced in field of analytical organic chemistry; extensive program to determine feasibility of irradiation sterilization of foods; $6000–$7600; East. (b) **Statistician** to serve as assistant or associate professor, university school of medicine. (c) **Neuro-physiologist,** experienced with recording action potentials from nervous system, advantageous if trained in neuroanatomy; research department of chemical company; $6500–$7000 if recently graduated Ph.D.; Midwest. (d) **Medical director;** duties include directing clinical work and development new drugs, medical writing, $10–$15,000. (e) **Senior clinical psychologist;** diagnostic clinic; excellent facilities; Pacific Coast. S9-2 Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

Physiologist to teach in Department of Physiology. Recent Ph.D. preferred. Box 240, SCIENCE. 9/17

Toxicologist for immediate appointment in State Health Laboratory. Doctorate in science or experience required. Starting salary $5760 to $8160, depending on qualifications. Write Glendon A. Scoboria, State Personnel Director, State Office Building, Hartford, Connecticut. 9/10

43 replies!!

Within ten days 43 replies were received to a single "Box Number" ad in the Personnel Placement section of SCIENCE. Your own ad, here, will produce prompt results, at a minimum cost. Send your "copy", now.

POSITIONS OPEN

SCIENTISTS—Salaried Positions, $6,000 to $35,000

This confidential service for outstanding Chemists, Engineers, Physicists, Metallurgists, etc. who desire a change of connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

TOMSETT ASSOCIATES • 435 Frick Bldg., Pittsburgh 19, Pa.

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

CLASSIFIED: 25¢ per word, minimum charge $6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis —provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . .

SCIENTIFIC PERIODICALS and BOOKS

Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted

WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

PROFESSIONAL SERVICES

ANALYSIS OF AMINO ACIDS AND PROTEINS

VITAMINS, MINERALS, FOODS, SPECIAL DETERMINATIONS

SHANKMAN LABORATORIES

2023 SANTA FE AVENUE, LOS ANGELES 21, CALIFORNIA

SINCE 1870

Food Ingredient & New Drug Studies

TOXICOLOGICAL STUDIES

LaWall & Harrisson

Bacteriologists
Chemists - Pharmacologists

Div. S, 1921 Walnut St., Philadelphia 3, Pa.

ANALYSES - CONSULTATION - RESEARCH

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

PROFESSIONAL SERVICES

WISCONSIN ALUMNI RESEARCH FOUNDATION

LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Mineral determinations including sodium and fluorine • Proximate analyses • Vitamin and amino acid assays • Food chemistry and microbiology • Enzyme investigations

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION

P. O. BOX 2059-V • MADISON 1, WISCONSIN

FOOD RESEARCH LABORATORIES, INC.

Founded 1922

Philip B. Hawk, Ph.D., President
Bernard L. Oser, Ph.D., Director

Research • Analyses • Consultation

Biological, Nutritional, Toxicological Studies for the Food, Drug and Allied Industries

48-14 33rd Street, Long Island City 1, N.Y.

• RESEARCH
• CONSULTATION
• ANALYSES

CONSULTATION RESEARCH

MICROBIOLOGY
PHARMACOLOGY
BIOCHEMISTRY
TOXICOLOGY
ANIMAL HISTOPATHOLOGY

SOUTH SHORE
ANALYTICAL AND RESEARCH LABORATORY, Inc.
148 ISLIP AVE. ISLIP, N. Y.

LOOKING FOR A PUBLISHER?

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.

VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1
In Calif.: 6356 Hollywood Blvd., Hollywood 28

SUPPLIES AND EQUIPMENT

All AMINO ACIDS natural, synthetic, unnatural, Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.

BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.

RATS

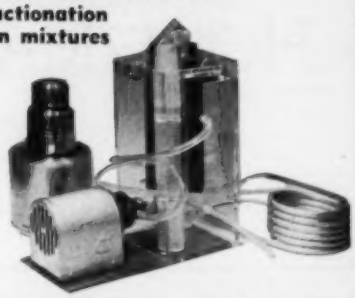
Long-Evans (PAF)
Wistar (PAF)

Bred for Research Work by Research Workers

PACIFIC ANIMAL FARMS
2457 Fletcher Dr., Los Angeles 39, Calif.

SUPPLIES AND EQUIPMENT

ELECTROCONVECTION
for fractionation of protein mixtures



See:
Proc. Soc. Exp. Biol. Med. v. 81, p. 278 (1952)

Send for free bibliography of electrophoresis-convection

E-C APPARATUS CO. 27 Haven Avenue New York 32, N. Y.

STAINS

• RARE
• COMMON
Price list on Request

STARKMAN Biological Laboratory • 461 Bloor St., W. Toronto, Canada

• **HYPOPHYSECTOMIZED RATS**

Shipped to all points via Air Express
For further information write

HORMONE ASSAY LABORATORIES, Inc. • 8159 South Spaulding Ave. Chicago 29, Ill.

SPRAGUE–DAWLEY, INC.

Pioneers in the development of the

STANDARD LABORATORY RAT

Our new modern colony building just completed soon will double our present production.

The new colony building contains every device to insure continuous production and shipment of guaranteed Sprague-Dawley strain white rats.

Limited shipments of males from the new colony will be available about March 15, 1954.

Increased orders from our present customers and orders from new customers will be accepted as production builds up.

OUR PLEDGE: Our insistence on the highest possible quality will never be sacrificed to quantity.

SPRAGUE–DAWLEY, INC. P.O. BOX 2071 Madison, Wisconsin

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

SUPPLIES AND EQUIPMENT

SUPPLIES AND EQUIPMENT

HOLTZMAN RAT COMPANY

. . . Continuity of Quality & Dependability of Supply

Route 4, Badger Lane · Madison 5, Wisc. · Phone 6-5573

• *Hamsters* • *Guinea Pigs* • *Rabbits* •

• *Rats* • *Mice*

RESEARCH

MANOR FARMS

Staatsburg, New York

Tel. Staatsburg 3278

Supplying every Research Need Since 1943

• *Cats* • *Dogs*

MACHLETT

Your assurance of the finest laboratory supplies, scientific instruments, chemicals and glassblowing.

E. Machlett & Son • 220 E. 23rd St. • N. Y. 10, N. Y.

Ask For GBI Price List

GBI research products, in convenient small packages—are offered as a special service to investigators. They will save you time, trouble and expense if you are engaged in research in these fields. →

BIOLOGICAL

MICROBIOLOGICAL

BACTERIOLOGICAL

BIOCHEMICAL

NUTRITIONAL

←*Write for this useful reference book listing hundreds of items for research.*

...GBI.. **General Biochemicals, Inc.**

72 LABORATORY PARK, CHAGRIN FALLS, OHIO

SCIENCE - 1954 ON MICROCARDS

The response to the 1953 Microcard edition has encouraged us to make volume 119 of SCIENCE available in this form. Thirty-nine 3" x 5" cards contain all 1,512 pages of SCIENCE from January through June 1954.

The space saving is considerable. 25 sets of Microcards take up approximately the same space as a single bound volume of SCIENCE covering the same period. The bother and expense of binding is completely eliminated. In spite of a 14% increase in volume, the price remains unchanged:

Microcard edition of SCIENCE, 1953 $15.00
" " January-June 1954 $ 7.50

Orders may be placed with:

AAAS
1515 Mass. Ave., N.W.
Washington 5, D. C.

TACONIC FARMS

Germantown, N. Y.

Germantown 3535

- **Swiss Mice**
- **Webster Strain**

BEAGLES

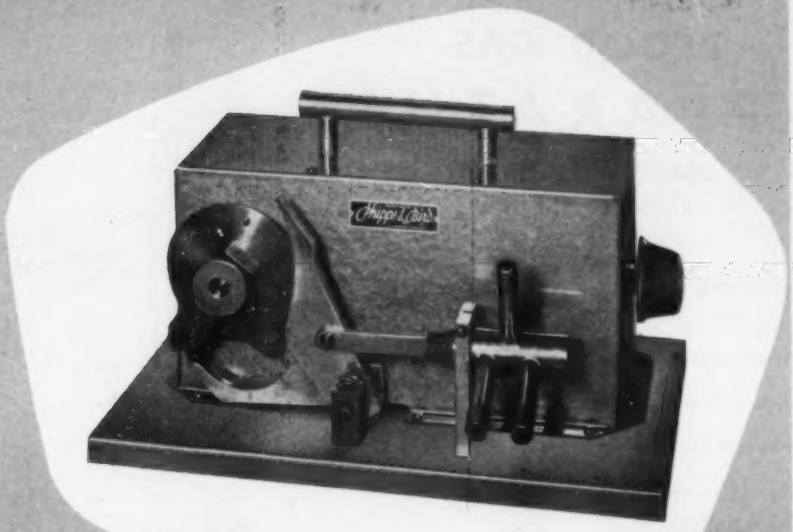
Healthy — AKC Registered — Immunized

$25 to $50 each; F.O.B. Ithaca

J. FATULA — *Dog Farm* — RR1 — Ithaca, N. Y.

PHIPPS & BIRD

VARI-PHASE VALVE



FOR CONTROLLING ARTIFICIAL RESPIRATION

This valve in conjunction with a source of compressed air is used to control artificial respiration.

Control of one knob facilitates respiration rates of 15 to 50 per minute. The inspiration to expiration time ratio may be set to any value between 1:4 to 4:1. By loosening one screw the valve may be removed for cleaning and sterilizing.

For operation on 115-volt, 60-cycle only.

CAT. NO. 71-216 $125.00

PHIPPS & BIRD, INC.

MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

6TH & BYRD STREETS — RICHMOND, VA.

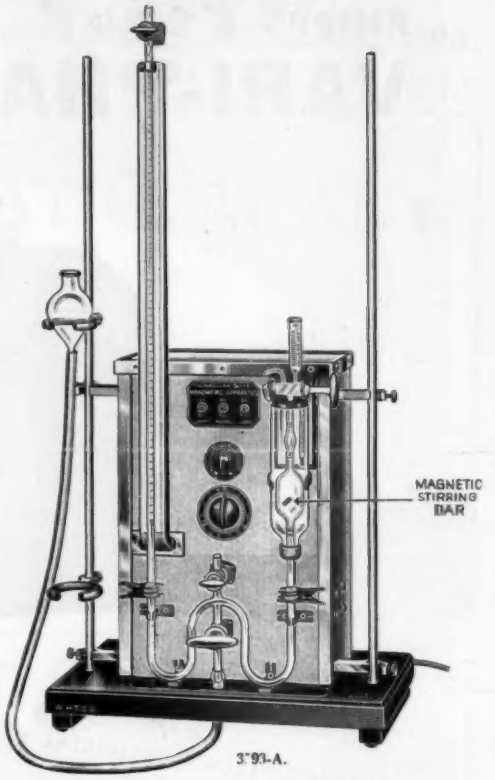
The first major improvement since the original Van Slyke design . . . . .

THOMAS–VAN SLYKE

MANOMETRIC BLOOD GAS APPARATUS

MAGNE-MATIC MODEL

(Patent Applied For)



3593-A.

- **Magnetic agitation instead of violent mechanical shaking**
- **Stationary, vertical extraction chamber**
- **Ball-and-socket ground glass joints**
- **Built-in timer**
- **Corrosion-resistant housing and base**

The contents of the chamber are agitated by a small Kel-F coated magnetic stirring bar, which is readily inserted and is floated by the rising mercury into the chamber where it is held by the field of the driving magnet and rotated in a vertical plane at a speed controlled by the rheostat. Its small volume has no significant effect upon the measured pressure.

This new method of agitation permits a *stationary chamber*, thereby reducing the costly breakage experienced because of the vibration due to the former method of violent shaking, and assures that the chamber is constantly vertical for rapid adjustment of meniscus, convenient addition of reagents, etc. The former troublesome rubber connection between the chamber and the manometer is replaced by a ball-and-socket ground glass joint, permitting quick removal of the chamber for cleaning, etc.

Other improvements have been incorporated, i.e., automatic timer in series with the motor switch, for reproducible periods of agitation; large handle on the lower stopcock for better flow control; housing of corrosion-resistant Formica and Stainless steel; Formica base with trough for spilled mercury; spring tension clips on the stopcock plugs; unique illumination by means of a clear plastic column which carries the light and also serves as a support for the manometer; metal handle for the leveling bulb (not shown in illustration); all controls mounted on front panel; and rods at both sides for supporting accessory equipment as required.

3593-A. **Thomas-Van Slyke Manometric Blood Gas Apparatus, Magne-Matic** (Patent applied for), complete as shown in illustration, with improved type glassware, two magnetic stirring bars, 16 oz. Polyethylene wash bottle, clamps, tygon tubing, etc., but without mercury or pipettes. For 115 volts, a.c. or d.c. **310.00**

Copy of Bulletin 120 sent upon request.

SYMBOL OF QUALITY
A.H.T.CO. SPECIFICATION
LABORATORY APPARATUS

ARTHUR H. THOMAS COMPANY

Laboratory Apparatus and Reagents

WEST WASHINGTON SQUARE PHILADELPHIA 5, PA.

Teletype Services: Western Union WUX and Bell System PH-72